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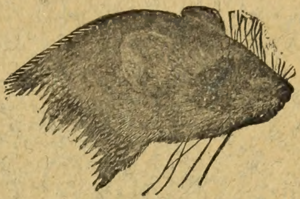
HENRY W. HENSHAW, *Chief*

NORTH AMERICAN FAUNA

No. 33

[Actual date of publication, August 17, 1911]



A BIOLOGICAL SURVEY OF COLORADO

BY

MERRITT CARY
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

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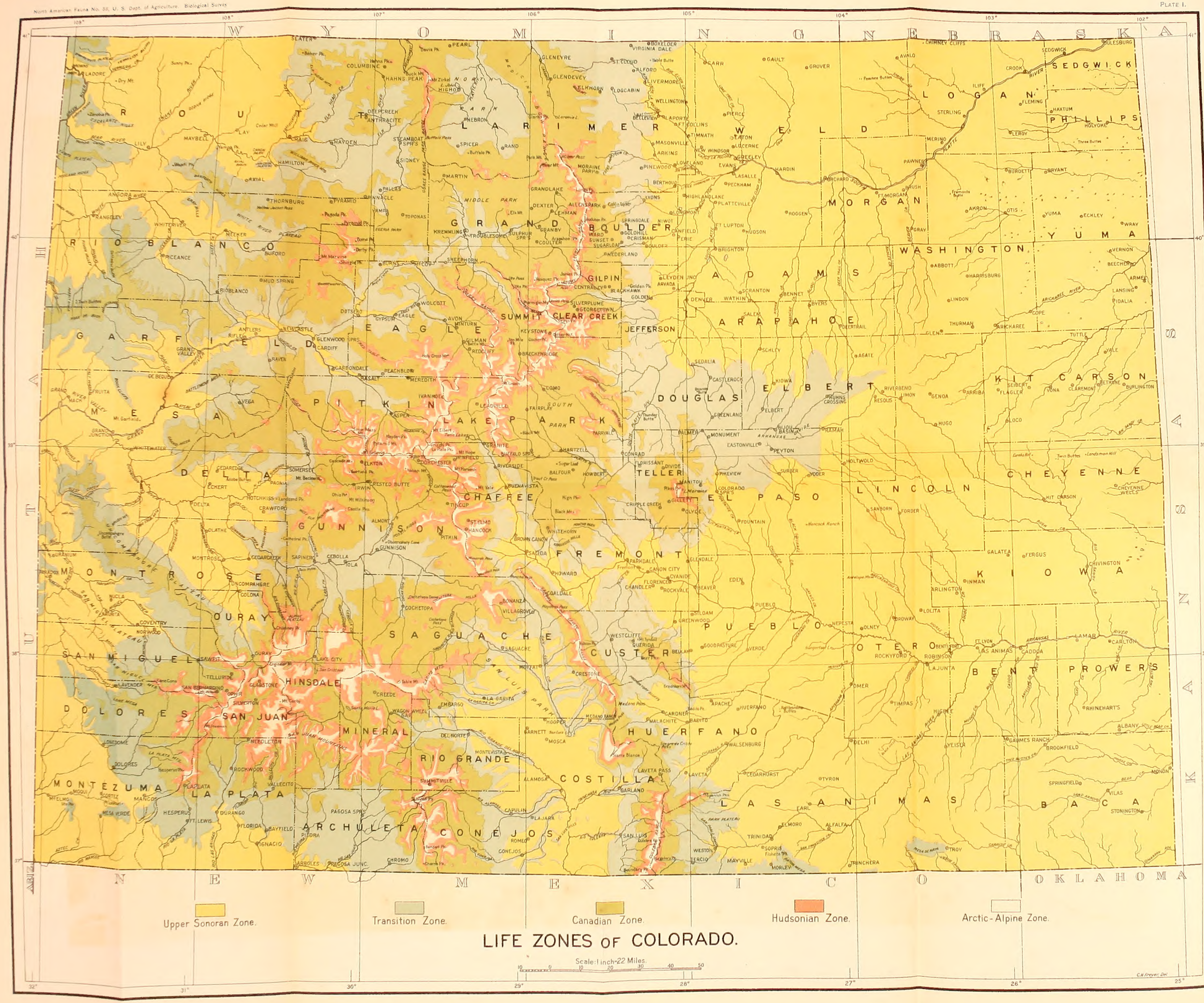
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SAN JUAN
DOLORES
MINERAL
HUERFANO
RIO GRANDE
COSTILLA
MONTEZUMA
LA PLATA
ARCHULETA
CONEJOS
LAS ANIMAS
BACA
Upper Sonoran Zone.
Transition Zone.
Canadian Zone.
Hudsonian Zone.
Arctic-Alpine Zone.

LIFE ZONES OF COLORADO.

Scale: 1 inch-22 Miles.

C.H. Freyer, Del.

U. S. DEPARTMENT OF AGRICULTURE
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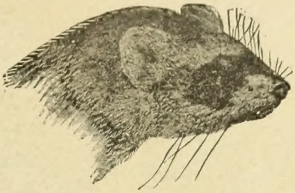

A BIOLOGICAL SURVEY OF COLORADO

BY

MERRITT CARY
ASSISTANT BIOLOGIST, BIOLOGICAL SURVEY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1911

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Biological Survey,
Washington, D. C., February 21, 1911.

Sir: I have the honor to transmit herewith for publication as North American Fauna No. 33 a report on the results of a biological survey of Colorado, by Merritt Cary. The report consists of three sections. The first characterizes the five life zones which traverse the State, defines their extent and limits, and discusses their agricultural and economic possibilities. The second consists of a complete list of the mammals of Colorado with brief notes on their habits, distribution, and economic relations. The third is a list of the principal trees and shrubs of Colorado observed by the assistants of the Biological Survey during the progress of work in the State, with annotations as to their distribution and abundance.

Respectfully,

Henry W. Henshaw,
Chief, Biological Survey.

Hon. James Wilson,
Secretary of Agriculture.

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No. 33. NORTH AMERICAN FAUNA. August, 1911.

A BIOLOGICAL SURVEY OF COLORADO.

By Merritt Cary.

INTRODUCTION.

Colorado, because of its diverse and striking physical features, presents an interesting field for natural-history investigations, and has received more than ordinary attention from naturalists. Nevertheless, prior to 1905 the distribution of mammals and birds had been studied in detail over only a few small areas, chiefly on the eastern slope of the main ranges, on the adjacent plains, and in the southern end of the San Luis Valley. Field work in the more accessible parts of the State by several field naturalists of the Biological Survey had accumulated important series of specimens and valuable data on the fauna and flora. Many perplexing problems of geographical and vertical distribution and relationships of species, however, remained to be solved. Moreover, the intimate connection and correlation between the natural life zones and crop zones of the country, as pointed out by Dr. Merriam,[1] made increasingly apparent the lack of information respecting Colorado. The data on the distribution of species in Colorado available at the beginning of 1905 proved entirely inadequate for a detailed study of the life zones, although the need of accurate delimitation of the zones constantly increases as vast areas are opened to agriculture and horticulture through modern methods of conserving and distributing the water supply.

Accordingly, in 1905, the writer was directed to undertake a biological reconnoissance of certain of the least-known sections of northern Colorado with a view to the completion of a detailed survey of the State. Field operations were begun early in June of that year. Preliminary work in the mountains of Boulder, Jefferson, and Clear Creek Counties was followed by a wagon trip from Boulder across the range to Middle Park by way of Rollins Pass; north over the western end of the Rabbit Ear Mountains into North Park; thence west to Steamboat Springs, crossing the Park Range over Buffalo Pass, and down the Bear River Valley as far as Axial Basin. Traveling southward over the Danforth Hills to Meeker and across the White River Plateau, the expedition finished its season's work in the Grand River Valley.

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[1] Life Zones and Crop Zones of the United States, by C. Hart Merriam, Bull. 10, Biological Survey, U. S. Dept. Agric., 1898.

Field work was continued in northern Colorado in 1906. Again outfitting at Boulder, I made a wagon trip of much greater length, completely encircling the area covered in 1905.[1] The route was along the northern and western boundaries of the State, from Boulder north to Fort Collins; west over the Medicine Bow Range to North Park; across the northern end of the Park Range to Hahns Peak and Slater; down the Snake River Valley to the Escalante Hills and northwest to Browns Park, on Green River; thence south to Rangely, on White River, and over the Book Cliffs to Mack, in the Grand River Valley; northeast in the valleys of Grand and Eagle Rivers to Wolcott; north to Egeria Park; east across the Gore Range to Middle Park; and back to Boulder by way of Berthoud Pass and Black Hawk.

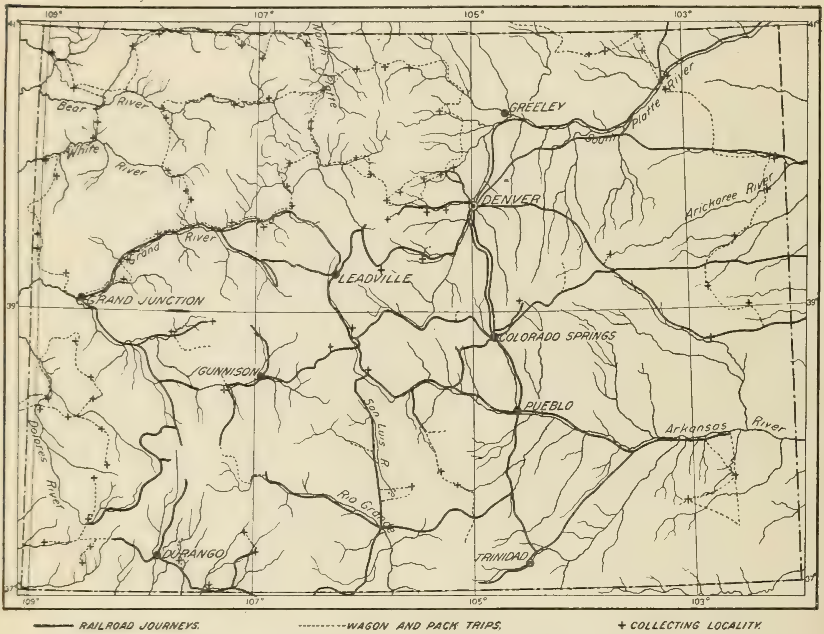
109°
107°
105°
103°
41°
39°
37°
North Platte
Bear River
White River
GREELEY
South Platte River
DENVER
Arickaree River
Grand River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
San Luis R.
Dolores River
Arkansas River
Rio Grande
DURANGO
TRINIDAD
RAILROAD JOURNEYS.
WAGON AND PACK TRIPS.
+ COLLECTING LOCALITY.

FIG. 1.—Map of Colorado showing routes and collecting localities of Merritt Cary, 1905, 1906, 1907, and 1909.

The field season of 1907 was devoted to a detailed study of zonal conditions in all the important physiographic areas of southern Colorado, including a trip into the little known La Sal Mountains along the boundary of eastern Utah. Owing to the extent of territory covered, the railroads were largely utilized for travel, but many side trips were made by stage and pack train.

---

[1] The ready resource of my camp assistant, Mr. Walter Blanchard, of Boulder, contributed greatly to the success of the wagon trips of both 1905 and 1906. Over much of the region traveling was arduous and on some of the high mountain passes even dangerous.

Knowledge was still lacking as to the distribution of a great many plains species along the eastern edge of the State, and further work in that region was deemed necessary. Consequently part of the field season of 1909 was spent on the Arkansas Divide and on the plains from Cheyenne Wells northwest to Sterling, Colorado, and Cheyenne, Wyoming. This trip, although of short duration, filled in an important gap and yielded valuable distribution data.

In studying the life zones of Colorado it has been necessary to collect many mammals, birds, reptiles, and plants, illustrating climatic variation, and to work out in detail the geographic and vertical distribution of all characteristic zone species. In regions devoted to agriculture and stock raising, the economic relations of both mammals and birds have been carefully investigated. Valuable information bearing on the past and present ranges and abundance of the larger game mammals and carnivores has been acquired from hunters, trappers, and sportsmen of wide experience in the State.

The present report is based chiefly on the field work prosecuted during 1905, 1906, 1907, and 1909. It is primarily a characterization of the several major distribution areas or life zones, and their geographical and vertical boundaries as here defined are believed to be approximately correct and in sufficient detail for all practical purposes. (See frontispiece.) In the course of three seasons' work it is obviously impossible to run continuous zone lines in a rough and broken region like the mountainous two-thirds of Colorado. To insure reasonable accuracy the zone limits have been checked up both horizontally and vertically by crossing the important mountain ranges, plateaus, and mesas at different latitudes; while abnormal variations of zone level resulting from peculiar physiographic conditions have received special attention.

The report on life zones is supplemented by a chapter on the distribution of trees and shrubs. Many notes on birds and reptiles are incorporated in the sections of life zones to which the different species belong.

The list of Colorado mammals, in addition to the results of the four seasons' investigations conducted by the writer, contains a large amount of important unpublished data collected prior to 1905 by the following naturalists of the Biological Survey: Vernon Bailey, Dr. A. K. Fisher, Edward A. Preble, Arthur H. Howell, J. Alden Loring, and Clark P. Streator. Among the local naturalists whose work has contributed materially to the completeness of the mammal report should be mentioned E. R. Warren, of Colorado Springs, the author of important publications on the mammals of Colorado.

New species of mammals have been described from time to time from the material collected by the Biological Survey in Colorado. Among the mammals collected in southern Colorado in 1907 were three new forms. Owing to unavoidable delay in the publication of the present report, these have been characterized by Dr. Merriam in the Proceedings of the Biological Society of Washington as follows: *Eutamias minimus caryi*, *Neotoma albigula warreni*, and *Thomomys talpoides agrestis*.[1]

In preparing the mammal report I have freely used the collection of the Biological Survey and the private collection of Dr. C. Hart Merriam, both in the United States National Museum. I am indebted to Gerrit S. Miller, jr., curator of mammals in the National Museum, for access to the collections under his charge. Dr. Leonhard Stejneger, of the same institution, has identified the reptiles and batrachians. Dr. J. N. Rose and his assistants have named many of the plants.

EFFECT OF PHYSIOGRAPHIC AND CLIMATIC FEATURES OF COLORADO ON FAUNAL AND FLORAL DISTRIBUTION.

Colorado is no exception to the rule that a region of varied climatic and physiographic conditions possesses a correspondingly large and varied fauna and flora. That it is surpassed by a few other States in the variety of its animal and plant life is due, not so much to a lack of varied physical conditions as to the absence of climatic extremes. The comparatively rich fauna and flora of the State are largely due to the great range of altitude in the mountains, since the high basal plane lies entirely within the arid region. Colorado has neither the extent of latitude nor the low, hot areas of great humidity or aridity which contribute to the wonderfully rich fauna and flora of such States as California and Texas. The extensive eastern plains, the Rocky Mountain system traversing the central part, and the rough region of alternating plateaus, desert valleys, and mesas on the western slope, divide the State into three general topographic regions, each occupying approximately a third of its total area. Dissimilar physical and climatic conditions still further divide these into smaller irregular areas which differ considerably in their fauna and flora. Thus, on the western slope, high mesas, clad with a scrubby and more or less scattering forest growth receiving moderate rainfall, alternate with lower arid desert stretches (some with less than 10 inches of annual rainfall), while in the mountains are extensive belts of heavy forest with much greater humidity (20 to 25 inches annual rainfall) and bare alpine crests and summits above timberline having a truly arctic climate.

East of the mountains are found the fauna and flora peculiar to the Great Plains region, with a slight admixture of Mississippi Valley species in the river valleys along the eastern boundary of the State.

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[1] Proc. Biol. Soc. Wash., XXI, pp. 143–144, June 9, 1908.

The lower elevations on the western slope have a strong infusion of desert species, characteristic of the Great Basin region. The Rocky Mountain system has a complex fauna and flora—the foothills, the open valleys and parks, the dense forests of the central slopes, and the alpine summits, all having associations of mammals, birds, and plants, which are more or less distinctive.

Altitudinal variation in Colorado has a pronounced effect upon both temperature and moisture, and accounts for great extremes in summer and winter temperatures in different sections, and also for a wide range between night and day temperatures throughout the year. At Grand Junction (4,500 feet) the winter and summer mean temperatures are 29° and 75° F.; at Gunnison (7,600 feet) they are 11° and 59°; at Breckenridge (9,500 feet) they are 16° and 52°; while along the summits of the main mountain ranges the temperatures are still lower.

As temperature is a very important factor in the distribution of life, Colorado is an exceptionally favorable field for illustrating vertical distribution. In fact, the wide range of elevation, from 3,000 and 4,000 feet along the eastern boundary to considerably over 14,000 feet on the summits of the main ranges, furnishes favorable conditions for characteristic species of five of the seven major life zones of North America. Thus, in passing from the plains of eastern Colorado to the summit of either the Front or Sangre de Cristo Ranges, or from the warm desert valleys or sage plains of the western counties eastward to the crest of the Continental Divide, the following life zones are successively traversed: (1) Upper Sonoran, which includes all the basal plane of the State from which the mountains rise; (2) Transition or yellow-pine zone, occupying the foothill region; (3) Canadian, or zone of coniferous boreal forests, comprising the lodgepole pine, aspen, fir, and spruce belts of the middle mountain slopes; (4) Hudsonian, or belt of dwarfed conifers, extending to timberline; and (5) Arctic-Alpine zone, reaching from timberline to the summits of the highest mountain peaks. With the exception of the first named, all are included in full width, and the lower border of the Upper Sonoran zone is nearly reached in some of the low desert valleys of the southwest. Of the above zones the Upper Sonoran and Transition alone are of agricultural importance. Their adaptation to various crops is discussed under their respective headings.

The Austral element (Upper Sonoran zone) occupies territory aggregating nearly half the area of the State, or about twice as much as the Boreal element (including Canadian, Hudsonian, and Arctic-Alpine zones). The region of overlapping austral and boreal species (Transition zone) is about equal in extent to that occupied by the boreal zones.

On the eastern slope of the front ranges, as a result of the relatively abrupt ascent from the base level of the plains, the several life zones are usually restricted to horizontally narrow and well-defined belts. West of the Continental Divide, however, they often cover broad and extensive areas, as the incline of the country is more gradual. There is, moreover, in consequence, a decided overlapping of species for a considerable horizontal distance, rendering the zonal limits less clearly defined than on the steeper slopes. The boundaries of the zones in western Colorado are extremely irregular and sinuous, owing to the broken and diversified character of the country, and especially to the warm desert valleys which enter the State from the west and deeply penetrate and parallel the westward extending boreal plateaus and mountains.

The vertical breadth of the zones is much the same on both sides of the Continental Divide. The zone levels, however, are a few hundred feet higher on the warmer western slope, particularly in northern Colorado. In southern Colorado the combined effects of lower latitude and more elevated base level are noticeable in higher zone levels, which are about the same on both sides of the Continental Divide.

The vertical boundaries assigned the several zones are necessarily approximate, since various governing factors, chief among which are slope exposure, steepness of slope, and deforestation, either force species above their normal limits or restrict their limits below normal. On the border of each zone is a belt of varying vertical breadth (usually from 400 to 800 feet) in which species of the two bordering zones commingle. The following table gives the extreme vertical limits of zones in Colorado:

Extreme vertical limits of zones in Colorado.

Zone.	Northern Colorado.		Southern Colorado.	
	Northeast exposure.	Southwest exposure.	Northeast exposure.	Southwest exposure.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Upper Sonoran	...... to 5,600	...... to 6,500	...... to 6,500	...... to 7,800
Transition	5,600 to 7,500	6,500 to 8,200	6,500 to 8,000	7,800 to 9,000
Canadian	7,500 to 10,000	8,200 to 10,400	8,000 to 10,500	9,000 to 11,000
Hudsonian	10,000 to 10,900	10,400 to 11,600	10,500 to 11,200	11,000 to 12,000
Arctic-Alpine	10,900 to	11,600 to	11,200 to	12,000 to ......

UPPER SONORAN ZONE.

The entire base level of Colorado, comprising territory aggregating nearly half its area, or about 50,000 square miles, lies within the Upper Sonoran or arid division of the Upper Austral zone. As it is preeminently the agricultural zone of the State, it will be characterized in considerable detail.

East of the mountains the Upper Sonoran zone occupies a broad and continuous area of nearly uniform width, comprising the plains region, besides a stretch of rough and broken juniper country south of the Arkansas River and a narrow strip along the easternmost flanks of the foothills up to the point where the junipers (*Juniperus monosperma*) and pinyons (*Pinus edulis*) give way to the yellow pines of the Transition zone—at an elevation varying from 5,300 to 6,000 feet north of the Arkansas Divide, and from 6,200 to 7,300 feet farther south, according to the exposure and steepness of the foothill slopes. The upper (western) boundary of the eastern Colorado Upper Sonoran is tolerably regular from the Wyoming line south to the Arkansas Divide, where it bends far eastward to skirt this extensive Transition area. South of the Divide its regularity is further broken by a long, narrow arm which penetrates the mountains as far as Buena Vista, in the warm valley of the Arkansas, and to a less degree by westward extensions in the valleys of the Huerfano, Cucharas, and Las Animas Rivers still farther south. The following localities in the eastern foothill region well indicate the upper limit of the Upper Sonoran zone: Livermore, Arkins (2 miles west), Lyons, Boulder, Golden, Sedalia, Ramah (Arkansas Divide), Pikeview, Manitou (Fountain Creek Valley), Buena Vista (Arkansas Valley extension), Malachite (Huerfano Valley), La Veta (Cucharas Valley), and Weston (Las Animas Valley).

In western and southern Colorado the Upper Sonoran element occupies much smaller and extremely irregular areas. It is largely confined to long and sinuous arms or tongues in the warm, semidesert river valleys, which penetrate deeply the boreal country of the mountains and plateaus; but it also crosses some of the intervening watersheds at their lowest elevations and everywhere occupies the lowest slopes of mesas, plateaus, and ridges to an altitude of about 6,500 feet, regularly reaching 7,500 or even 7,800 feet on the steep southwestern slopes which many of the elevations present to the hottest rays of the sun.

West of the Continental Divide the Upper Sonoran zone embraces two regions of irregular outline separated in Colorado by the boreal cap of the Book Cliffs, although connected along the Green River Valley in Utah. The northern and smaller of these two areas is a southward extension of the Red Desert Upper Sonoran of Wyoming, connecting across the divide south of Bear River with the White River Valley extension of the Utah Upper Sonoran. Practically all of Routt and Rio Blanco Counties below 6,500 feet is included within this area. The northern half (western Routt County) is a region of extensive sage plains, while the rough region contiguous to the White River drainage is for the most part clothed with pinyons and junipers. The eastern and southern limits of this area are reached at or near the following localities: Dixon, Wyoming, Snake River Valley; Fortification, Colorado, west base Elk Head Mountains; half way between Hayden and Craig, Bear River Valley; north base Williams River Mountains; Hamilton, Williams Fork of Bear River; Axial, Axial Basin; north bases of Yampa and Wapiti Peaks; middle southwestern slopes of Danforth and Gray Hills; and northern base of White River Plateau, east in a rapidly narrowing tongue to a point on White River about 15 miles southeast of Meeker, where the Upper Sonoran is restricted to a narrow strip of pinyons and junipers occupying the warm southwestern slopes of the lowest hills bordering the river on the north. Narrow tongues extend southward in the valleys of Piceance and Bitter Creeks; thence the zone includes the eastern and northern bases and lower western slopes of Cathedral Bluffs, the northern bases of the Book Cliffs, and most of the valley of Evacuation Creek. In extrême western Routt County the westward continuity of the Upper Sonoran is interrupted by three arms of high country which extend a short distance into the State from Utah—the O-wi-yu-kuts Plateau and Diamond Peak on the north; the eastern extension of the Uinta Mountains, terminating in Mount Cullom, west of Green River; and, still farther south, the Yampa Plateau. East of Green River it is still further broken by the summits and upper northern slopes of the Escalante Hills, which form a Transition and Canadian zone island separated from the Uinta Mountains on the west and the Yampa Plateau on the south by a narrow tongue of Upper Sonoran zone extending through the Ladore Canyon of Green River on its warm eastern side and along the north side of the Yampa Canyon of Bear River.

South of the Book Cliffs the Upper Sonoran zone covers broad belts in the lower desert valleys of the Grand, Gunnison, Dolores, and San Juan Rivers and their chief tributaries. Over most of this region the pinyons, junipers, and other characteristic Upper Sonoran species of plants, birds, and mammals reach their limit of upward dispersion at a little over 7,000 feet elevation, but the variation due to slope exposure in a region so broken and incised is such as to prevent exact delimitation. Thus on the exposed southern faces of the Book Cliffs, from the Utah line east to the Little Book Cliffs, the upper limit conforms closely to the 7,000-foot contour; while on the remarkably bold and exposed slopes on the southwestern extremity of Grand Mesa, north of Delta, and also on the Landsend Peak, the most western point of the West Elk Mountains—unbroken slopes which rise directly out of the desert to a great height—the belt of junipers and pinyons can be traced to considerably over 8,000 feet, and probably occasionally reaches 8,500 feet. Looking north from Delta (4,950 feet) in the bottom of the Gunnison Valley to the bold southwest slope of Grand Mesa, a striking view is obtained of

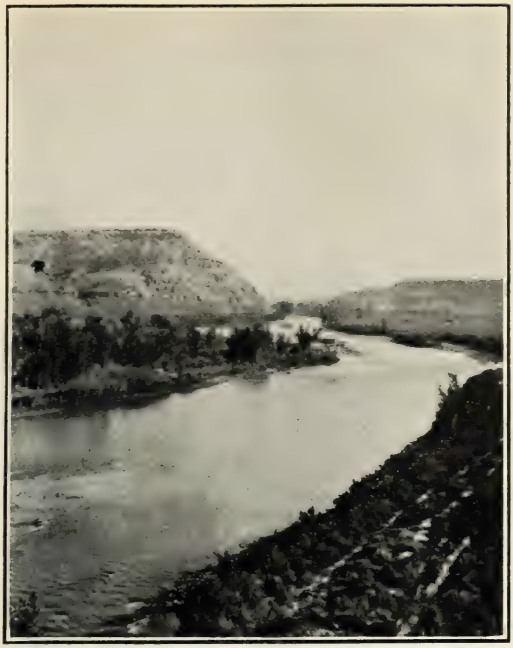

FIG. 1.—GRAND RIVER VALLEY NEAR DE BEQUE, SHOWING STRIP OF UPPER SONORAN ZONE.

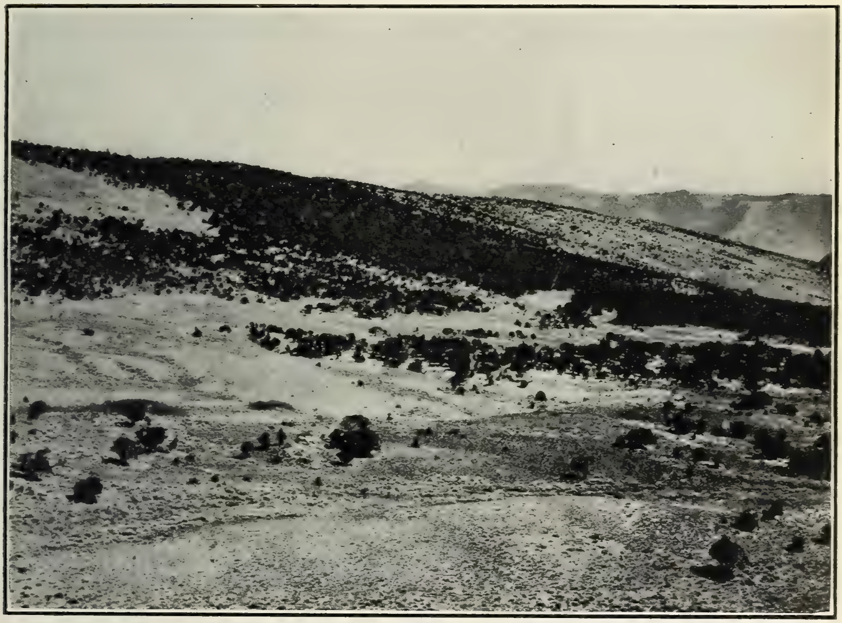

FIG. 2.—POCKET OF UPPER SONORAN ZONE ON SOUTHERN SLOPE, AT 7,500 FEET. NEAR MCCOY, GRAND RIVER VALLEY.

perhaps the greatest vertical breadth of the Upper Sonoran zone visible at any point in the State. In contrast to the conditions on warm exposed slopes is the cooling effect exerted by north and especially northeast slopes and canyon sides, shaded during the greater part of the day, and also by mountain streams, which together create an environment unfavorable for Upper Sonoran species above 6,000 feet. Examples of these conditions appear on the south side of Grand River below Glenwood Springs and also in the Grand Canyon a few miles above, where the Douglas spruces and other Transition zone forms occupy the slopes to below 6,000 feet; in constrictions of the Unaweep Canyon, which cuts through the Uncompahgre Plateau near its northern end; and in a great many other localities.

The Grand Valley Upper Sonoran enters Colorado from the Utah deserts in a broad belt and penetrates the high country in a long and sinuous tongue for over 150 miles in an east-northeast direction. East of Palisade, where the Little Book Cliffs and Grand Mesa approach each other, it is greatly narrowed, but again widens to include the valleys of Plateau and Roan Creeks. Between De Beque and Newcastle it is confined to a strip 2 or 3 miles wide along Grand River (see Pl. II, fig. 1), and east of Newcastle occupies a still narrower strip along the north side of the valley to Glenwood Springs, continuing up the Roaring Fork to Basalt. The continuity of the Upper Sonoran in the Grand Valley is broken by the Transition environment obtaining through the entire length of the Grand Canyon, from Glenwood to Dotsero, but the zone is again encountered in dilute form on the warm southern slopes of the lowest hills along the north side of Eagle River nearly to Wolcott. The Grand Valley between Dotsero and McCoy was not explored, but a well-defined Upper Sonoran pocket 4 or 5 miles in width was traversed on the northern side of the river at McCoy. At this point both pinyons and junipers were growing on the warm southern slopes up to 7,800 feet. (Pl. II, fig. 2.) The Upper Sonoran belt in the Gunnison and Uncompahgre Valleys is uniformly broad, and covers a greater area than that in the Grand Valley, of which it is an offshoot. Its eastern and southern limits are marked by Somerset (North Fork of Gunnison River), near River Portal (Gunnison Canyon), between Cedar Creek and Cerro Summit, and near Portland (Uncompahgre Valley).

Another extension of the Grand Valley Upper Sonoran follows southeast along the Dolores River, widening in the San Miguel and Paradox regions to include practically all the rough canyon country between the western escarpment of the Uncompahgre Plateau and the eastern flanks of the La Sal Mountains. Norwood is very near the eastern limit of the Upper Sonoran in the San Miguel Valley, and

Lavender marks its upper edge on Disappointment Creek, south of the San Miguel Mountains. South of the junction of the Disappointment with the Dolores this area connects across an extensive sage desert with a northward extension of the San Juan Upper Sonoran area, which covers practically all the extensive desert region lying west of Dolores River and south of the La Plata Mountains. Continuing eastward in the San Juan drainage, arms of this zone extend northward in the valleys of all northern affluents—along the Rio Las Animas to Durango, along the Rio Pinos nearly to Bayfield, and on the Rio Piedra to a point opposite the Piedra Padre, while along the San Juan it reaches nearly to Trujillo.

The intermountain region is penetrated by the Upper Sonoran zone only in the Rio Grande Valley. An arm of considerable breadth enters this region from New Mexico along the Rio Grande, where it is well characterized in a wide strip on each side of the river nearly as far as Alamosa. In a dilute form the Upper Sonoran element spreads over most of the open country as far as Del Norte, and north over the level plains of the San Luis Park to a little beyond Moffat. It includes also the belt of junipers and pinyons on the hot foothill slopes of the San Juan and Garita Mountains on the west and on the lower flanks of the Sangre de Cristo Range on the east side of San Luis Valley to an elevation of 8,500 feet, or about 1,000 feet above the mean level of the valley. The cold water in the many side streams of San Luis Valley—the Conejos, La Jara, Alamosa, Saguache, San Luis, Trinchera, Culebra, and the branches of the Rio Grande above Alamosa—carries narrow strips of Transition zone far out into the plain, and the immediate valleys of these streams can not be included in the Sonoran area.

The Upper Sonoran zone includes within the State two well-marked subdivisions differing considerably in their physical characteristics. These are the Great Plains region of eastern Colorado and the Great Basin region of western Colorado including San Luis Valley. Since each possesses a fauna and flora in a large degree peculiar and distinctive, they will be treated as minor distribution areas.

Great Plains Division of the Upper Sonoran Zone.

With the exception of Las Animas County and parts of Pueblo, Otero, Bent, and Baca Counties, practically all of Colorado east of the foothills is a vast undulating grassy plain which varies in elevation from 3,000 and 4,000 feet along the eastern boundary to between 5,000 and 6,000 feet where it approaches the foothills. Throughout this region strips of sandy country alternate with areas of firm soils. The chief rivers are the Platte and Arkansas, which, with their many small tributary streams, drain most of the eastern part of the State through shallow valleys. A large number of these tributaries indicated upon maps are dry most of the year, and only a small proportion are perennial. Rock exposures are infrequent, being found chiefly in the eastern tier of counties, where some of the streams of the Republican River drainage, in seeking a lower level, have worn through beds of sandstone; and in northeastern Weld and northwestern Logan Counties. The plains are devoid of natural tree growth, except along the watercourses, which are usually fringed with cottonwoods, various species of willows, and dense thickets of wild plum and cherry, with scattering clumps of hackberry and box elder in the neighboring gulches and arroyos. A little sagebrush is found toward the north, in Weld and adjoining counties, but over most of the region the limited shrubbery is confined to the stream valleys. Range grasses in great variety grow luxuriantly on the plains and form the dominant vegetation.

The fauna and flora of this region are essentially those of the Great Plains, from Nebraska and South Dakota to the Panhandle of Texas. The following associations of mammals, birds, plants, and reptiles are more or less characteristic.

MAMMALS OF GREAT PLAINS.

Those mammals of the plains of eastern Colorado which are restricted to the Upper Sonoran zone are the large spotted and Kennicott spermophiles (*Citellus spilosoma major* and *C. obsoletus*); pale grasshopper mouse (*Onychomys leucogaster pallescens*); white-footed mouse (*Peromyscus leucopus tornillo*[1]); harvest mouse (*Reithrodontomys nebrascensis*); wood rats (*Neotoma cinerea rupicola, N. floridana baileyi,* and *N. micropus canescens*[2]); Hayden vole (*Microtus ochrogaster haydeni*); pocket gophers (*Geomys lutescens* and *Cratogeomys castanops*[3]); kangaroo rat (*Perodipus montanus richardsoni*); pocket mice (*Perognathus flavescens, P. flavus, P. hispidus paradoxus*); black-tailed jack rabbit (*Lepus californicus melanotis*); Bailey cottontail (*Sylvilagus auduboni baileyi*); long-tailed skunk (*Mephitis mesomelas varians*); prairie spotted skunk (*Spilogale interrupta*); long-eared and hairy-lipped bats (*Myotis evotis* and *M. californicus ciliolabrum*).

Other mammals which have their center of abundance in the Upper Sonoran zone, but are not entirely restricted to it, are the antelope (*Antilocapra americana*); striped spermophile (*Citellus tridecemlineatus pallidus*); prairie dog (*Cynomys ludovicianus*); white-footed mouse (*Peromyscus maniculatus nebrascensis*); coyote (*Canis nebracensis*); swift fox (*Vulpes velox*); badger (*Taxidea taxus*);

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[1] In brush fringe along streams only.

[2] Only in extreme southeast.

[3] Only in southeastern counties.

black-footed ferret (*Putorius nigripes*); long-tailed weasel (*Putorius longicaudus*); and the Say and brown bats (*Myotis subulatus* and *Eptesicus fuscus*).

BREEDING BIRDS OF GREAT PLAINS.

Among the characteristic Sonoran birds which breed on the plains are the following: California cuckoo (*Coccyzus americanus occidentalis*); burrowing owl (*Speotyto cunicularia hypugæa*); Arkansas kingbird (*Tyrannus verticalis*); Bullock oriole (*Icterus bullocki*); western grasshopper sparrow (*Ammodramus savannarum bimaculatus*); western lark sparrow (*Chondestes grammacus strigatus*); lazuli bunting (*Passerina amœna*); western blue grosbeak (*Guiraca cærulea lazula*); Bell vireo (*Vireo belli*); long-tailed chat (*Icteria virens longicauda*); catbird (*Dumetella carolinensis*); brown thrasher (*Toxostoma rufum*); and western mockingbird (*Mimus polyglottos leucopterus*).

Other birds breeding commonly on the plains, which are not so closely restricted to the Upper Sonoran zone, are: Upland plover (*Bartramia longicauda*); long-billed curlew (*Numenius americana*); mountain plover (*Podasocys montanus*); black-crowned night heron (*Nycticorax n. nævius*); bobwhite (*Colinus virginianus*); ferruginous rough-legged hawk (*Archibuteo ferrugineus*); mourning dove (*Zenaidura macroura carolinensis*); kingbird (*Tyrannus tyrannus*); thick-billed redwing (*Agelaius phœniceus fortis*); western meadowlark (*Sturnella neglecta*); bronzed grackle (*Quiscalus quiscula æneus*); lark bunting (*Calamospiza melanocorys*); western vesper sparrow (*Poœcetes gramineus confinis*); Brewer sparrow (*Spizella breweri*); white-rumped shrike (*Lanius ludovicianus excubitorides*); western yellowthroat (*Geothlypis trichas occidentalis*); and yellow warbler (*Dendroica æstiva*).

PLANTS OF GREAT PLAINS.[1]

Aside from the trees and larger shrubs along streams, including cottonwood (*Populus occidentalis*), several species of willows (*Salix*), box elder (*Acer negundo*), hackberry (*Celtis reticulata*), buffalo berry (*Lepargyrea argentea*), golden currant (*Ribes longiflorum*), wild plum (*Prunus americana*), chokecherry (*Prunus melanocarpa*), wolfberry (*Symphoricarpos occidentalis*), sumac (*Schmaltzia trilobata*), and false indigo (*Amorpha angustifolia*), the most conspicuous plants and smaller shrubs of the plains region are:

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[1] Throughout this report, with a few exceptions, the botanical nomenclature used is that of Rydberg, Flora of Colorado, Bull. 100, Colo. Agric. College Experiment Station, 1906.

Amorpha canescens.
Aragallus lamberti.
Artemisia filifolia.
Atriplex canescens (local).
Asclepias (several species).
Astragalus mollissimus.
Astragalus crassicarpus.
Cactus missouriensis.
Chrysothamnus plattensis.
Gaura coccinea.
Gutierrezia sarothræ.
Glycyrrhiza lepidota.
Helianthus lenticularis.
Ipomaea leptophylla.
Laciniaria punctata.
Leucocrinum montanum.
Lithospermum linearifolium.
Lupinus pusillus.
Malvastrum coccineum.
Meriolix serrulata.
Oenothera (several species).
Opuntia polyacantha.
Opuntia arborescens (Arkansas Valley and southward).
Peritoma serrulatum.
Petalostemon villosum.
Petalostemon oligophyllus.
Petalostemon purpureus.
Plantago purshi.
Psoralea lanceolata.
Psoralea hypogea.
Psoralea tenuiflora.
Prunus besseyi (in sandy country).
Touterea stricta.
Touterea nuda.
Townsendia (several species).
Ratibida columnaris.
Verbena hastata.
Verbena bracteosa.
Yucca glauca.

The following list of conspicuous grasses of the Great Plains of eastern Colorado is taken from a recent report of the Bureau of Plant Industry:[1]

Agropyron smithi.
Andropogon furcatus.
Andropogon halli.
Andropogon scoparius.
Aristida longiseta.
Bouteloua curtipendula.
Bouteloua hirsuta.
Bouteloua oligostachya.
Buchloe dactyloides.
Calamovilfa longifolia.
Festuca octoflora.
Koeleria cristata.
Muhlenbergia gracillima.
Muhlenbergia pungens.
Munroa squarrosa.
Panicum virgatum.
Redfieldia flexuosa.
Schedonnardus paniculatus.
Sitanion hystrix.
Sporobolus cryptandrus.
Stipa comata.

REPTILES AND BATRACHIANS OF GREAT PLAINS.

Most of the reptiles of eastern Colorado are common to the semi-arid part of the Great Plains. Aside from the rattlesnake (*Crotalus confluentus*), bull snake (*Pituophis sayi*), blue racer (*Bascanion constrictor*), and hog-nosed snake (*Heterodon nasicus*), lizards are the most noticeable reptiles, particularly in sandy tracts. These comprise, among others, the horned toad (*Phrynosoma ornatissimum*), sand swift (*Holbrookia maculata*), whip-tailed lizard (*Cnemidophorus gularis*), and *Sceloporus consobrinus.* A large, beautifully colored ring-necked lizard (probably *Crotaphytus collaris*) reaches the plains of eastern Colorado in Baca County, in the extreme southeast, where it is reported as not uncommon. A salamander (*Ambystoma tigrinum*) from Loveland is in the Biological Survey collection.

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[1] Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production in the Great Plains Area. Bureau of Plant Industry Bull. 201, pp. 20–62, March 16, 1911.

GREAT BASIN DIVISION OF UPPER SONORAN ZONE.

The Upper Sonoran area of Colorado lying in the drainage of the Rio Grande and Colorado Rivers is an integral part of the Great Basin region and differs from the Great Plains area in more arid climate and more barren and deeply eroded surface. A large proportion of its plants and animals are Great Basin forms, either specifically or subspecifically different from those of the Great Plains. Its open areas are generally characterized by the bunch-like growth of desert shrubs commonly termed sagebrush, grease brush, and rabbit brush, and the foothills and valley margins by a scrubby growth of junipers and nut pines. This area is best considered under its local subdivisions.

COLORADO RIVER DRAINAGE.

The territory embracing the open reaches in the warm lower valleys from Snake River south to the San Juan possesses a fauna and flora characterized by a large number of Great Basin desert forms, few of which show appreciable differentiation in passing through the entire width of the western Colorado Upper Sonoran. Considered locally, however, with respect to both faunal and physical characteristics, the Colorado River drainage readily admits of division into two minor distribution areas—the northwestern and southwestern sections.

NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A broad expanse of undulating sandy plains and low watersheds lying chiefly north of Bear River in west central Routt County is characterized by a dense growth of sagebrush (*Artemisia tridentata*). With an average elevation of 6,000 feet, this region is higher than the desert valleys to the south and has a mixture of Transition species in its fauna and flora. Its plants and animals, unlike those of the valleys of the Colorado drainage farther south, are partly derived from the Great Plains. The trees and shrubs, consisting of scattered cottonwoods, dense copses of willows, and thickets of buffalo berry, are confined to the banks of watercourses. A sparse growth of juniper covers the canyon sides and the steep faces of bluffs. The region is drained by the Snake and Bear Rivers, which flow through valleys of considerable depth—often through rugged canyons.

MAMMALS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The following mammals characteristic of the Routt County sage plains have reached that region from the west and north, and most of them are absent from the southwestern valleys: The least chipmunk (*Eutamias minimus*), Wortman ground squirrel (*Callospermo-*

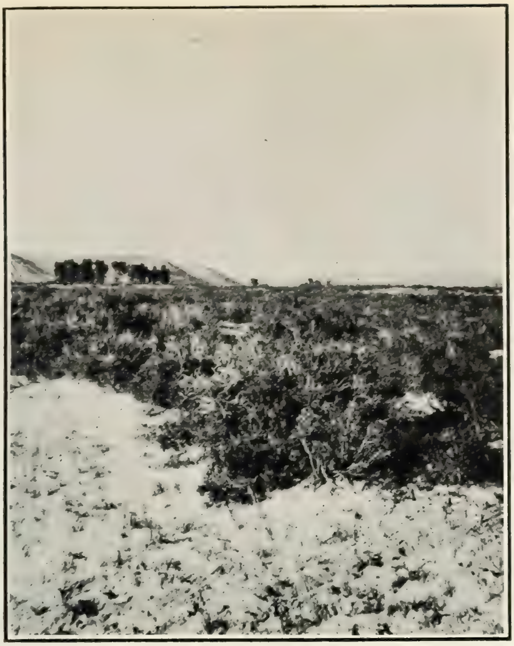

FIG. 1.—GREASEWOOD (SARCOBATUS VERMICULATUS) IN LOWER SNAKE RIVER VALLEY, ROUTT COUNTY.

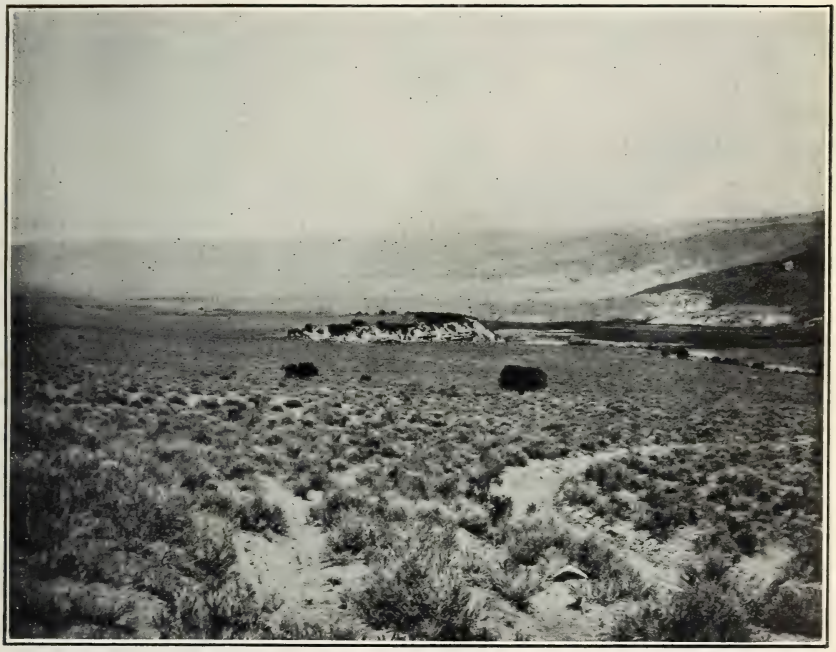

FIG. 2.—BENCH BORDERING VALLEY OF VERMILION CREEK, NORTHWESTERN ROUTT COUNTY.

The shrubbery is *Atriplex confertifolia* and *Grayia spinosa*, with *Juniperus monosperma* on bluffs.

philus lateralis wortmani), little striped ground squirrel (*Citellus tridecemlineatus parvus*), Idaho grasshopper mouse (*Onychomys leucogaster brevicaudus*), Red Desert pocket mouse (*Perognathus callistus*), Green River pocket gopher (*Thomomys clusius ocius*), and Fort Yuma bat (*Myotis yumanensis*). Species derived from the Great Plains region are *Peromyscus maniculatus nebrascensis*, *Perodipus montanus richardsoni*, *Sylvilagus auduboni baileyi*, *Canis nebracensis*, and *Myotis californicus ciliolabrum*. The long-eared bat (*Myotis evotis*) occurs on the plains on both sides of the mountains. Species which are common over this area but which regularly range higher are: *Lepus campestris townsendi*, *Citellus elegans*, *Cynomys leucurus*, *Neotoma cinerea orolestes*, and the gray wolf and antelope.

BREEDING BIRDS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The sage sparrow (*Amphispiza nevadensis*), Brewer sparrow (*Spizella breweri*), and Bullock oriole (*Icterus bullocki*) are characteristic Upper Sonoran breeders in the low areas of northwestern Colorado, while the sage thrasher (*Oreoscoptes montanus*), white-rumped shrike (*Lanius ludovicianus excubitorides*), desert horned lark (*Otocoris alpestris leucolæma*), and San Diego redwing (*Agelaius phœniceus neutralis*) breed commonly but nest also in the Transition zone. The sage hen (*Centrocercus urophasianus*) is an occasional breeder, although restricted mainly to the Transition zone during the summer. Many Great Basin species of birds which are common breeders in the valleys of southwestern Colorado are noticeably absent from the northwestern valleys.

PLANTS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

Conspicuous shrubs and plants on the sandy sage plains of Routt County are *Artemisia tridentata*, *Opuntia polyacantha*, *Eurotia lanata*, and several species of *Chrysothamnus* and *Eriogonum;* on the adobe soil of the first and second benches above the streams, *Grayia spinosa*, *Atriplex nuttalli*, *A. canescens*, and *A. confertifolia* (Pl. III, fig. 2); on the alkaline flats in the valley bottoms, *Sarcobatus vermiculatus* (Pl. III, fig. 1), *Dondia erecta*, and, in damp places, *Salicornia herbacea;* on the rocky faces of bluffs, *Juniperus monosperma*, *Kunzia tridentata* (mainly Transition), *Ephedra antisyphylitica*, *Yucca glauca;* along streams, *Populus acuminata*, *Lepargyrea argentea*, *Salix amygdaloides*, and others.

REPTILES AND BATRACHIANS OF NORTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

Reptiles are few in number compared with those in the valleys farther south. Rattlesnakes (*Crotalus confluentus*) and horned toads (*Phrynosoma ornatissimum*) were the only reptiles noted on the sandy sage plains in August, 1905, although the dainty mottled *Sceloporus* *graciosus* was collected among the rock ledges along the Bear River bluffs near Maybell, and also on Snake River, 20 miles west of Baggs Crossing. The leopard frog (*Rana pipiens*) is common in the streams of this section, a specimen having been collected on Vermillion Creek, near Ladore, September 3, 1906.

Southwestern Section—Colorado River Drainage.

Although traversed by such large perennial streams as the White, Grand, Gunnison, Dolores, and San Juan, and their numerous tributaries, this is, throughout, a region of great aridity, and presents the only truly desert conditions found within the State. Although small in area it is of great importance from both a biological and a horticultural standpoint. Most of the region is below 5,500 feet, the Grand Valley below Grand Junction being under 4,500 feet. In the extreme southwest, however, a few desert areas reach 6,000 feet. The larger part of the soils are to be classed as adobe. In common with all arid desert regions, the warm valleys of southwestern Colorado, when brought under irrigation, are remarkably productive, especially of fruit.

MAMMALS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

The most representative of the mammals are the antelope squirrel (*Ammospermophilus leucurus cinnamomeus*), pale grasshopper mouse (*Onychomys leucogaster pallescens*), golden-breasted canyon mouse (*Peromyscus crinitus auripectus*), big-eared harvest mouse (*Reithrodontomys megalotis*), desert wood rat (*Neotoma desertorum*),[1] golden pocket gopher (*Thomomys aureus*), Moki kangaroo rat (*Perodipus longipes*), Apache pocket mouse (*Perognathus apache*), cottontail rabbit (*Sylvilagus auduboni warreni*), Texas jack rabbit (*Lepus californicus texianus*), cacomistle (*Bassariscus astutus flavus*), Arizona skunk (*Mephitis estor*), Great Basin spotted skunk (*Spilogale gracilis saxatilis*), coyote (*Canis estor*), and the bats, *Antrozous pallidus, Myotis californicus, M. evotis, Pipistrellus hesperus,* and *Nyctinomus mexicanus*.

BREEDING BIRDS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A few of the most characteristic breeding birds are the California quail (*Lophortyx californicus*),[2] ash-throated flycatcher (*Myiarchus cinerascens*), house finch (*Carpodacus mexicanus frontalis*), Arkansas goldfinch (*Astragalinus psaltria*), black-throated sparrow (*Amphispiza bilineata*), western blue grosbeak (*Guiraca cærulea lazula*), and canyon wren (*Catherpes mexicanus conspersus*). Practically all the Upper Sonoran birds found on the northwestern sage plains breed more or less commonly in the desert valleys, as do also a number of species which are common to the Upper Sonoran areas on both sides of the mountains.

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[1] Taken in White River Valley only.

[2] Introduced.

PLANTS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

This region is especially marked by a large number of Upper Sonoran desert shrubs and plants, most of which extend into Colorado only a short distance on the west and southwest, being peculiar to the desert areas of the southwestern United States. Important among these are:

Berberis fremonti.
Coleogyne ramosissima.
Cowania mexicana.
Echinocactus whipplei spinosior (McElmo).
Ephedra antisyphylitica.
Ephedra torreyana.
Fraxinus anomala.
Grayia spinosa.
Lycium pallidum.
Opuntia whipplei.
Rhamnus smithi.
Yucca baccata.
Yucca harrimaniæ.

Other plants and shrubs of more general distribution in the Colorado Upper Sonoran which are found commonly in the southwestern desert valleys are:

Atriplex confertifolia.
Atriplex canescens.
Atriplex nuttalli.
Dondia erecta.
Eurotia lanata.
Echinocereus paucispinus.
Lepargyrea argentea.
Opuntia camanchica.
Opuntia rhodantha.
Populus wislizeni.
Populus acuminata.
Sarcobatus vermiculatus.
Schmaltzia trilobata.
Ximenesia exauriculata.

REPTILES AND BATRACHIANS OF SOUTHWESTERN SECTION—COLORADO RIVER DRAINAGE.

A large variety of reptiles, especially lizards, characterize the Upper Sonoran zone in the hot valleys and on the slopes of western Colorado, and several lizards which reach their greatest abundance in the Lower Sonoran zone of the southwest United States are represented. Probably all have reached this region from the southwestern deserts. Following are some of the most important reptiles, with brief notes on their distribution:[1]

Crotaphytus collaris baileyi.—This ring-necked lizard is abundant in the McElmo and Montezuma Valleys, east to a point 6 miles north of Cortez, at 6,500 feet; also in the San Miguel region ranging east to Coventry (6,500 feet); present in west Paradox Valley (western rim at 6,500 feet), Salt Canyon, and other branches of the canyon of the lower Dolores River. Equally common on open deserts and in rocky pinyon country. I took two specimens at McElmo, June 17, 1907, and one each at Coventry and Sinbad Valley, July 13 and 17, 1907.

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[1] Many of the lizards of the desert valleys range up for some distance into the pinyon belt; but as no species appears to be restricted to the upper part of the zone, the present list will include notes bearing on both these areas.

Uta stansburiana.—This little desert lizard has a general distribution from the Grand Valley southward, chiefly below 6,000 feet, but rarely to 7,000 feet (Spruce Tree Cliff Ruins, Mesa Verde). It was found in the following localities: Desert north of Mack; Plateau Creek; Coventry; Paradox Valley; Salt Canyon; Dolores River Canyon; and McElmo. A very abundant lizard, usually occurring among rocks, but often on the open desert. The specimens are from Mack, Plateau Creek, and De Beque, September 25 and 30 and October 1, 1906, and McElmo, June 18, 1907.

Uta ornata.—A rock-inhabiting species of delicate profile and slight build, often scarcely discernible on account of its peculiarly protective colors and thin body. Present in most of the valleys from Grand River south to the San Juan. Represented by six specimens from Plateau Creek, September 30, 1906, and one each from Mesa Verde (Spruce Tree Cliff Ruins, 7,000 feet), June 13, and Coventry, July 29, 1907, and observed in Sinbad Valley and at McElmo and Arboles.

Sceloporus elongatus.—The large gray scaly rock lizard has a wide distribution, north at least to Bear River, and ranging through the entire width of the Upper Sonoran zone, and also a short distance into the Transition zone. In eastern Colorado noted only at Arkins. Found chiefly about rocks. Specimens from Arkins; Escalante Hills (7,000 feet); Meeker; Rangely; Plateau Creek; and McElmo.

Sceloporus consobrinus.—A medium-sized species, inhabiting rock ledges in the pinyon and juniper country up to 7,000 feet. Smaller than the preceding species and not nearly so common. Specimens are from Douglas Spring (Escalante Hills); La Veta; and Arboles.

Sceloporus graciosus.—A small graceful lizard, usually noted among greasewood (*Atriplex* and *Sarcobatus*) in open valleys and desert flats, chiefly below 5,500 feet. It was common at the following localities: Escalante Hills; valleys of Texas and Evacuation Creeks in extreme western Rio Blanco County; lower Grand Valley north of Mack; Rifle; Coventry; and McElmo.

Phrynosoma ornatissimum.—Horned toads are common at McElmo and on the desert north of Mack, Mesa County, and are reported elsewhere between 5,000 and 6,000 feet.

Cnemidophorus tigris.—This large whip-tailed lizard ranges into the State only in the lowest and hottest desert valleys, extending up to about 5,500 feet. It is tolerably common in the lower McElmo Valley, and abundant in West Paradox and Sinbad Valleys and also in the Dolores River Canyon as far down as the mouth of West Creek, frequenting sandy flats which are clothed with *Atriplex* and *Sarcobatus*. It doubtless occurs also in the lowest part of the Grand Valley near the Utah boundary, as I found it on Plateau Creek, 5 miles east of Tunnel, Mesa County. Represented by two specimens from

Plateau Creek September 30, 1906, and one from McElmo June 18, 1907. This species has its center of abundance in the arid Lower Sonoran zone.

Cnemidophorus gularis.—A medium-sized species not uncommon in the lowest valleys below 5,500 feet, in same situations as *C. tigris.* I collected specimens at Grand Valley October 2, 1906, near McElmo June 22, 1907, and at Hotchkiss August 8, 1907. It was observed also in Salt Canyon and in the canyon of Dolores River near the mouth of West Creek.

Bascanion tæniatum.—This handsome and graceful snake enters the State, so far as known, only in the Grand River Valley, where a specimen was taken on Plateau Creek September 30, 1906, and another at Morris, west of Rifle, August 13, 1907. The Plateau Creek individual climbed bushes with great ease, while the one from Morris was discovered among beds of prickly pear on a sandy knoll. Both localities are below 5,300 feet.

Thamnophis elegans vagrans.—This garter snake was taken at Meeker, Rio Blanco County, August 11, 1905.

Crotalus confluentus.—Rattlesnakes are not at all common, but are reported in most localities.

Pituophis sayi.—A bull snake was taken on Dry Creek, 8 miles west of Naturita, July 20, 1907.

Scaphiopus hammondi.—Numbers of these toads were caught in my mousetraps among beds of prickly pear on a sandy knoll at Morris, west of Rifle, August 15, 1907, at 5,200 feet.

Bufo lentiginosus woodhousei.—This toad was taken at Rangely September 12, 1906, and also at Rifle August 15, 1907.

Chorophilus triseriatus.—A specimen of this little frog was collected at Rangely September 13, 1906, at 5,500 feet.

RIO GRANDE DRAINAGE.

The Upper Sonoran element which follows up the Rio Grande Valley and in dilute form spreads over the level expanse of San Luis Park is mainly characteristic of the arid valleys of western Colorado. It includes among mammals *Antilocapra, Eutamias minimus caryi,*[1] *Citellus tridecemlineatus parvus, Onychomys leucogaster pallescens, Reithrodontomys montanus,*[1] *Thomomys aureus pervagus, Perodipus montanus,*[2] *Perognathus flavus* and *P. apache, Sylvilagus auduboni warreni,* and *Lepus californicus texianus* (?). Among plants and shrubs the various greasewoods (*Sarcobatus* and *Atriplex*), rabbit brush (*Chrysothamnus*), and sages (*Artemisia* and *Eurotia*) predominate, while *Gutierrezia, Grindelia, Helianthus, Ximenesia, Peritoma* (especially *P. sonoræ*), *Yucca,* and *Opuntia* are conspicuous genera on the arid plains. The Rio Grande, Conejos, and other streams are fringed in many places with thickets of *Ribes longiflorum* and *Schmaltzia trilobata*, while willows and broad-leaved cottonwoods are abundant.

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[1] Restricted to San Luis Park and Rio Grande Valley, so far as known.

[2] San Luis Park, Rio Grande Valley, and intermountain valleys of northern New Mexico.

JUNIPER AND PINYON BELT.

A belt of country clothed with juniper and pinyon, uniformly rough and broken in configuration, marks the higher part of the Upper Sonoran zone on the basal flanks of all the mountains in Colorado except the Front Range.[1] These two species (*Pinus edulis* and *Juniperus monosperma* [2]) form the characteristic tree growth on the slopes between the yellow pine belt of the higher foothills and the open plains or desert valleys at their bases. They also densely clothe extensive areas partially removed from the main mountain ranges, comprising in western Colorado practically all the lower elevations and the rough country forming the watersheds between the valleys (see Pl. IV), and east of the mountains a region of alternating canyons and ridges extending from southeastern Pueblo and eastern Huerfano Counties southeast to western Baca County. The pinyons grow to a higher elevation than the junipers, extending a short distance into the Transition zone. They occasionally reach 8,500 or 9,000 feet on hot slopes, as on the western side of the Sangre de Cristo Range, the eastern side of the Arkansas Valley between Salida and Buena Vista, and the bold southwest exposures of Grand Mesa and Sierra Blanca. They are not found as low as the junipers, however, and are usually absent from the rough areas below 5,500 feet.

Most of the mammals, birds, and plants of the juniper and pinyon country in Colorado are more or less characteristic of this belt over much of the Great Basin region. Few of the species are found on the Great Plains, and the fauna and flora as a whole belong to the Great Basin division of the Upper Sonoran zone.

MAMMALS OF JUNIPER AND PINYON BELT.

The following mammals represent the Upper Sonoran element in the juniper and pinyon belt in different parts of the State. On both slopes of the mountains: Rock squirrel (*Citellus variegatus grammurus*), cliff mice (*Peromyscus truei* and *P. boylei rowleyi*), and gray fox (*Urocyon cinereoargenteus scotti*). In western Colorado only: Hopi chipmunk (*Eutamias hopiensis*), golden-breasted canyon mouse (*Peromyscus crinitus auripectus*), Arizona wood rat (*Neotoma cinerea arizonae*), cacomistle (*Bassariscus astutus flavus*), Great Basin spotted

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[1] North of the Arkansas Divide the yellow pines of the Transition zone usually extend down to the edge of the plains, the juniper belt being but slightly indicated on a few outlying ridges and talus slopes by a very sparse growth.

[2] A third, *Juniperus scopulorum*, is common in the upper part of this belt, but also extends up through the Transition zone.

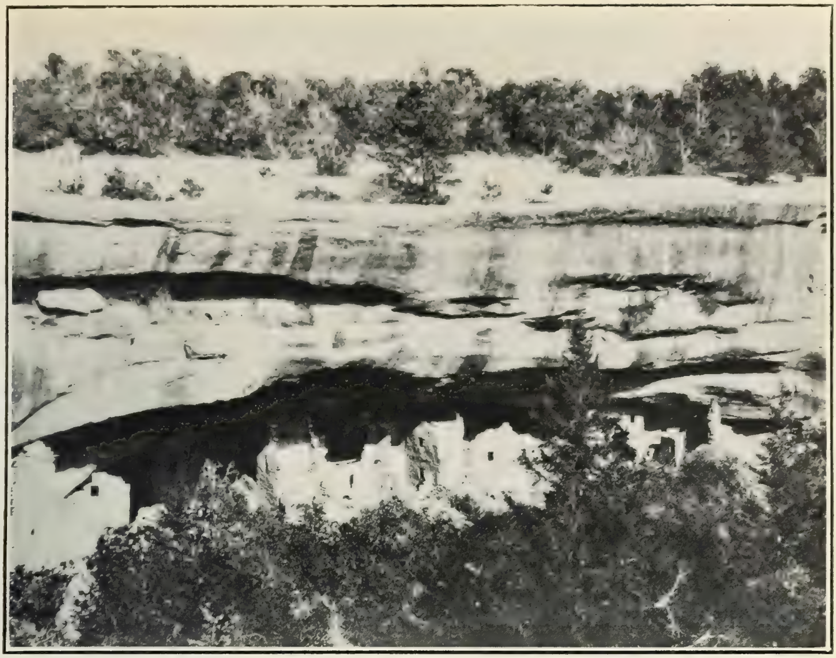

FIG. 1.—SPRUCE TREE CLIFF RUINS, NAVAJO CANYON, MESA VERDE, WITH JUNIPER AND PINYON FOREST IN THE ROUGH CANYON COUNTRY OF SOUTHWESTERN COLORADO.

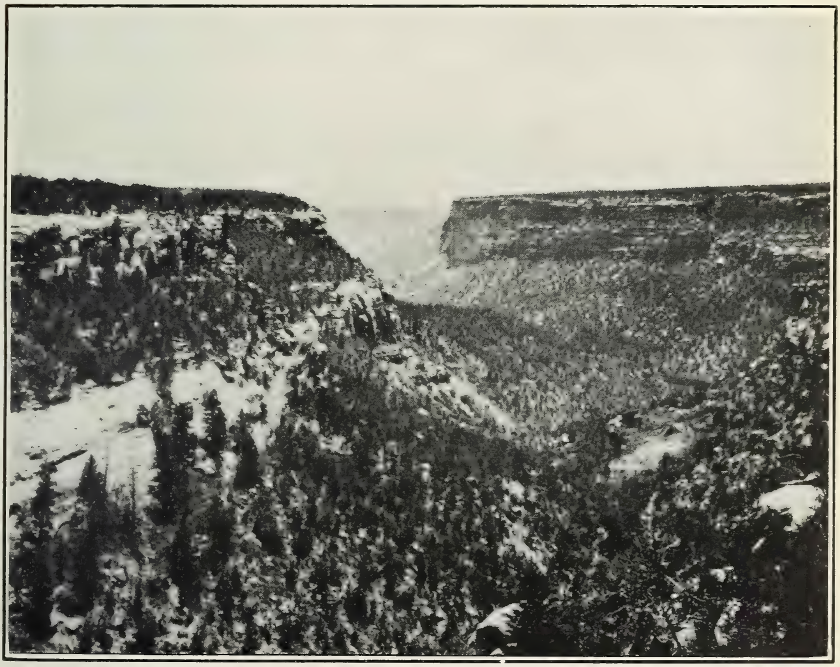

FIG. 2.—NAVAJO CANYON, MESA VERDE.

Characteristic view in rough canyon region of southwestern Colorado, showing dense growth of junipers and pinyons at 7,000 feet. Scattering Douglas spruces are on cool slope at left.

skunk (*Spilogale gracilis saxatilis*), and Arizona skunk (*Mephitis estor*). In the Escalante Hills: Utah chipmunk (*Eutamias dorsalis utahensis*). In southeastern Colorado: Warren wood rat (*Neotoma albigula warreni*).

BREEDING BIRDS OF JUNIPER AND PINYON BELT.

Breeding birds of general distribution in this belt are the Woodhouse jay (*Aphelocoma woodhousei*), pinyon jay (*Cyanocephalus cyanocephalus*), gray titmouse (*Bæolophus inornatus griseus*), lead-colored bush tit (*Psaltriparus plumbeus*), western gnat catcher (*Polioptila cærulea obscura*), and Baird wren (*Thryomanes bewicki bairdi*). The canyon towhee (*Pipilo fuscus mesoleucus*), scaled quail (*Callipepla squamata*), and the road runner (*Geococcyx californianus*) are common breeders in the juniper country of southeastern Colorado, but the quail and road runner breed also in the open valleys of the region and in the Lower Sonoran zone.

PLANTS OF JUNIPER AND PINYON BELT.

The vegetation of the juniper belt shows a great preponderance of Upper Sonoran species. Conspicuous among them are:

Juniperus monosperma.
Juniperus utahensis (west Colorado).
Pinus edulis (also lower Transition).
Fendlera rupicola.
Philadelphus microphyllus.
Fallugia acuminata (San Luis Valley region).
Cowania mexicana (southwestern Colorado).
Peraphyllum ramossissimum (also lower Transition).
Cercocarpus parvifolius.
Atriplex canescens (locally common).
Schmaltzia trilobata.
Quercus (several species).
Celtis reticulata (rare).
Ephedra antisyphylitica (west Colorado).
Ephedra torreyana (southwestern Colorado).
Echinocereus aggregatus (southeastern Colorado).
Echinocereus viridiflorus.
Cactus radiosus.
Opuntia arborescens (southeastern Colorado).
Opuntia whipplei (southwestern Colorado).
Yucca baccata (southern Colorado).
Yucca harrimaniæ (southwestern Colorado).

AGRICULTURAL IMPORTANCE OF COLORADO UPPER SONORAN ZONE.

Although entirely within the arid region and embracing areas of great aridity, the Upper Sonoran zone in Colorado is nevertheless of great agricultural importance. It is the only zone which affords suitable physical and temperature conditions for extensive and varied agriculture. With a light and insufficient annual rainfall, which varies from 15 or 20 inches on the eastern plains to less than 10 inches on some of the western desert tracts, and a remarkably dry atmosphere (average relative humidity about 50 per cent), the rich agricultural and fruit districts on both sides of the mountains have necessarily been developed largely by irrigation. It is true that a certain measure of success with corn, cane, and cereal crops is attained through dry farming in many sections on the eastern plains where no water for irrigation is available; and as the various systems of soil culture come into more general use and are made more effective in conserving rainfall, the hard and loam soil tracts should become increasingly productive. The great agricultural wealth of the State has been built up mainly, however, along the base of the foothills and in the valleys of the larger streams, and this area of greatest production will always be limited by the water supply.[1]

The distribution of Upper Sonoran crops is at present local; and so dependent are many of the crops upon natural protection, adequate water supply, and suitable soils, entirely aside from temperature, that they can not be grown over the whole of a region so varied as the Upper Sonoran of Colorado. The State is noted for its thrifty, scattered agricultural communities, some of which have become famous as producers of particular crops. Thus the production of potatoes on the plains of the Greeley region is enormous, as is also the yield of watermelons and cantaloupes at Rocky Ford, in the warm Arkansas Valley, and of peaches in the hot desert valley of Grand River near Grand Junction and Palisade. Sugar beets are a staple crop in the Platte and Arkansas Valleys, where a number of large sugar factories take care of the product, and they are grown extensively in the Grand Valley below Grand Junction. The raising of a great variety of vegetables on a large scale for canning is an important industry fostered by the establishment of several canneries in the region between Longmont and Fort Collins. Wheat and oats are important crops east of the mountains, and yield heavily under irrigation. Even the moderate yield now secured under dry farming warrants a large acreage under improved methods of handling the soil. Both of these cereals are successfully grown on moderate slopes and benches bordering many of the desert valleys in western Colorado. (See Pl. V, fig. 1.) A small acreage of corn is grown on the eastern plains, but it is not a sure crop west of the mountains, owing to the prevalence of cool nights during the growing season. Among the hay and forage crops alfalfa easily takes the lead, yielding two cuttings in the upper part of the zone, above 6,000 feet, and three or four in the warmer parts.

The leading fruit districts lie at the eastern base of the foothills and in the desert valleys of the western slope. The region from Boulder north to Fort Collins is noted for apples and small fruits, and most varieties of strawberries, raspberries, blackberries, currants, plums, and cherries thrive in this section. The Florence and Canon City district, in the Arkansas Valley, also is a heavy producer of berry

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[1] Vitally essential to the agricultural interests of the State are the mountain forests. Many authorities maintain that they induce precipitation; they also conserve moisture by holding the snows of winter, thus insuring a regular supply of water in the streams well into the growing season.

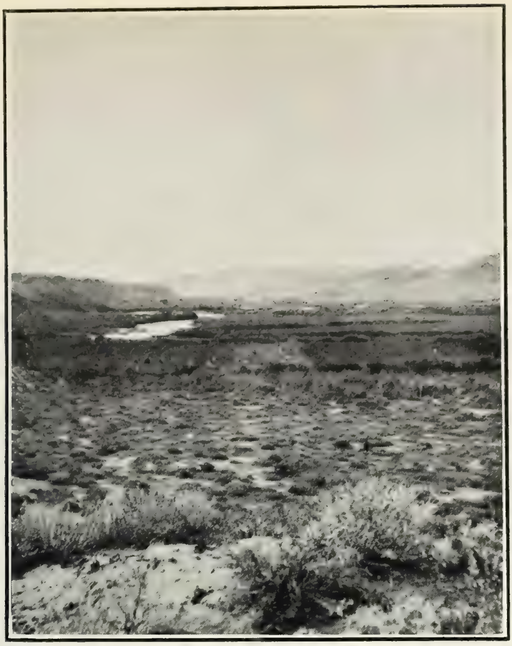

FIG. 1.—FARMS IN THE LOWER WHITE RIVER VALLEY BELOW RANGELY, AT 5,500 FEET.

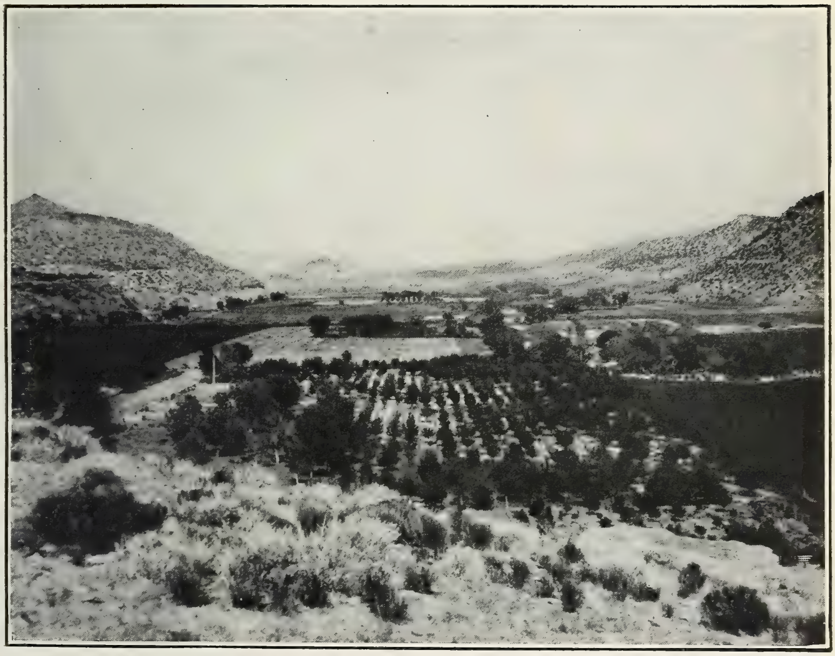

FIG. 2.—FRUIT RANCHES IN THE MCELMO VALLEY BETWEEN MOQUI AND MCELMO, AT 5,200 FEET.

fruits and apples. The western desert valleys are peculiarly adapted to a great variety of Upper Sonoran fruits, as apples, pears, peaches, prunes, apricots, and nectarines, while even almonds and peanuts have been successfully raised in a few of the warmer localities. (See Pl. V, fig. 2.) Many hundred carloads of peaches, apples, and pears are shipped annually from the lower Grand, Gunnison, and Uncompahgre Valleys, the chief shipping points being Fruita, Grand Junction, Palisade, Delta, Hotchkiss, Paonia, and Montrose. The adobe soils which prevail in most of the desert tracts prove wonderfully productive under irrigation, and the transformation wrought in a few years by water is little short of marvelous.

At present most of the eastern plains region and the sage plains of Routt County are used for grazing, but all the hard and loam soil tracts will doubtless eventually be brought under cultivation. The extensive sandy areas, with their luxuriant growth of range grasses, are well suited to grazing, but are also especially adapted to certain crops.[1] The short-grass plains which form the watershed between the Arkansas and Cimarron Rivers, in the extreme southeast, are arable throughout, and are being gradually reclaimed by dry-farming methods.

The intimate connection between the natural life zones and the crop zones has already been referred to. The same isotherms which limit the upward or northward dispersion of certain associations of native plants, birds, and mammals are found to limit effectively the successful production of certain fruits and other crops. The varieties of fruits, cereals, and miscellaneous crops which have proved best adapted to the Upper Sonoran zone in various parts of the western United States have been listed by Merriam.[2] In this zone the standard varieties of apples, plums, and cherries, the sugar beet, most of the cereals, and many other fruits and vegetables, reach their highest development and productiveness. It is not likely that all the varieties listed will prove an unqualified success in the Upper Sonoran of Colorado, but the tables furnish valuable aid in selecting suitable varieties. Presupposing suitable soil and water conditions, any intelligent fruit grower or farmer with a fair knowledge of the distribution and character of the Upper Sonoran element should be reasonably certain whether the proper temperature conditions for the maturing of particular fruits and crops are present in a given locality. Such knowledge is of special value along the upper edge of the zone, where, among the lower foothills and in regions of broken configuration, agriculture and horticulture, following the line of least resistance, are now very largely confined to the stream valleys. These are frequently descending tongues of the Transition zone, and the cooling influence of the streams very often causes the entire valley bottoms to be filled with Transition vegetation. From the nature of the case most of the Upper Sonoran fruits and crops tested in these valleys have proved either a total failure or only a partial success, and after long experimentation have been replaced by the hardier varieties of the Transition zone. Many of the experiments might have succeeded had they been tried in the warm pockets or on the moderately inclined slopes along the warm sides of the valleys, and had the rainfall been utilized by cross furrowing and ditching. These warm exposures are covered with Upper Sonoran vegetation, are occasionally open, but more often clothed with scattering pinyons and junipers, and in many cases, with a little clearing of rocks and shrubbery, are quite capable of cultivation. Many ranchmen have already discovered the advantages of such locations for fruit raising, but along the bases of the mountains are considerable areas of such land, still unreclaimed, which under present methods of conserving and handling the water supply are capable of producing the finest Upper Sonoran fruits.

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[1] Natural Vegetation as an Indicator of the Capabilities of Land for Crop Production, Bureau of Plant Industry Bull. 201, pp. 75-78, 1911.

[2] Life Zones and Crop Zones, Bull. 10, Biological Survey, pp. 37-40.

Although the larger part of the open San Luis and Rio Grande Valleys is included in the Upper Sonoran on the zone map, this region is very nearly on the border line between the Upper Sonoran and Transition zones, with a slight preponderance of Upper Sonoran species. This area is generally considered too cold for Upper Sonoran crops and fruits, and few have been grown thus far. This is not strange, however, since the part reclaimed for agriculture is very largely in valleys of streams, whose cooling effect precludes the successful cultivation of any but the hardy vegetables and cereals of the Transition zone. Warmer conditions are indicated on all the bordering foothill slopes by a belt of junipers, pinyons, and other Upper Sonoran vegetation, which extends from 1,000 to 1,500 feet above the level of the valley and continues out into the open country for some distance along the the warm sides of ridges. The warmest and most protected slopes are at the base of the foothills, and many of them are open and, with little clearing, suitable for cultivation. That certain of the hardier Upper Sonoran fruits, particularly apples,[1] can be successfully grown on these warm, protected slopes, wherever water is obtainable, seems highly probable, and the advantage of fruit growing in an extensive isolated agricultural region like the San Luis Valley is apparent.

An advantage of fruit raising in the foothills is the protection they afford from the cold winds which sweep the plains in winter. An added advantage is that, owing to the altitudinal difference in the progress of the season, fruit in the foothill districts often escapes injury from a late spring frost which catches the fruit of the lower country in full blossom. This was notably the case in 1907, when late frosts were general over the fruit districts on both sides of the mountains, greatly diminishing the crop.

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[1] In various parts of the southwest the pinyon belt has proved especially adapted to apples. Perhaps the best example within the State is in Montezuma Valley and the neighboring country, where in the natural openings and clearings among the pinyons the very finest apples are grown. When water from the several large ditches now under construction is available, apple growing will become one of the most important industries of southwestern Colorado.

The protection afforded in the foothill valleys of western Colorado is especially favorable to peach growing. The lower edge of the pinyon belt appears to limit the successful growing of peaches, nectarines, tomatoes, and melons over most of the region, but under favorable conditions peaches have been grown somewhat higher. In eastern Colorado peach growing is not carried on to any great extent. At Canon City the average is about two crops every five years. This failure is not due to coldness of climate, for the mean temperature is unusually high, but to long spells of warm weather in winter, which cause the buds to start, whereupon a sudden cold snap freezes them.

The many long arms or extensions of the Upper Sonoran zone in western Colorado have a special value in that, deeply penetrating the high country of the Transition and Boreal zones, they enable the cultivation of Sonoran fruits and crops to be carried far within regions devoted to mining and stock raising, and thus render their production more lucrative than elsewhere. An excellent example is the narrow, semidesert Grand River Valley, between Grand Junction and Glenwood Springs.

With the completion of the Gunnison Tunnel (through which water from the Gunnison River is to reach 150,000 acres of desert land in the Uncompahgre Valley) and many other private irrigation projects of less scope, the ranchmen of western Colorado in particular are rapidly awakening to the great possibilities of irrigation and to the fact that fruit raising is far more remunerative, acre for acre, than ranching and hay raising.

TRANSITION ZONE.

In general this may be said to be the foothill zone of Colorado, with its lower limit marked by the edge of the plains on the east and by the approach to desert conditions along the western bases of the mountains and plateaus. It is a neutral distribution area of considerable breadth lying between the Boreal (Canadian) and Austral (Upper Sonoran) regions, and elements of both zones enter about equally into its composition. Although a number of species of mammals, birds, and plants are wholly or mainly restricted to the Transition zone and characterize it locally, it is best marked on the whole as a region of overlapping boreal and austral species.[1]

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[1] See Merriam, Proc. Biol. Soc. Wash., VII, p. 31, 1892.

In addition to occupying continuous belts in the broken foothill country which flanks both sides of the main ranges, the Transition zone covers large areas in North Park, the upper Bear River Valley, the Wet Mountain Valley, Archuleta County south of the San Juan Mountains, on the Arkansas Divide with the adjacent region bordering the South Platte, and elsewhere. Many outlying elevations in western Colorado, chiefly secondary plateaus descending toward the Colorado River, are capped with this zone. Among these are the Mesa Verde, in Montezuma County, and the Yampa Plateau and Escalante Hills in western Routt County. It covers also most of the mountains west of the Ladore Canyon of Green River, forms a narrow belt around the Canadian zone summit of the O-wi-yu-kuts Plateau, occupies the summits of the higher eastward projecting flanks of the La Sal Mountains in western Montrose County, and is present in dilute form (indicated by pockets of *Pseudotsuga*) on the upper northeast faces of the Rabbit Hills, in western Rio Blanco County. On the east side of the mountains the only Transition zone island of consequence is on the summit of the Mesa de Maya, in southern Las Animas County. The total area in Colorado covered by the Transition zone is in the neighborhood of 25,000 square miles, or approximately one-fourth of the area of the State.

Warm slopes in various parts of the State having an unusual exposure to the direct rays of the sun carry Transition species anywhere from 500 to 1,000 feet above the mean zone level. A few examples are a southwest slope 1 mile northeast of Lake San Cristobal, near Lake City, where scattering yellow pines are encountered up to 10,000 feet; at Bath, on the summit of Trout Creek Pass, and along the western slopes of the Trout Pass Hills, where the same tree occurs regularly up to 9,500 feet and sparingly among the Douglas firs for another 300 feet; and on the eastern slope of the Sangre de Cristo Range in the Mosca Pass region, where the pines are common at 9,500 feet. Transition zone vegetation is carried to an abnormal elevation also on the remarkably exposed southwest slopes of Sierra Blanca and Grand Mesa, and on Badito Peak, the southernmost point of the Wet Mountains. (See Pl. VI, fig. 1.)

An excellent illustration of warmer environmental conditions created through deforestation, and a consequent upward extension of Transition zone species, is afforded on the mountains north of and adjacent to Clear Creek, just east of Fall River. The southwest side of a mountain between Fall River and Russell Gulch is clothed to the summit, at 9,000 feet, with a dwarfed growth of *Pinus scopulorum*, intermixed with *Pseudotsuga mucronata* and *Pinus flexilis*, and such shrubs as *Acer glabrum* and *Cercocarpus parvifolius*. The upper 500 feet of this slope is said to have been forested with *Pinus murrayana* in early days before mining activities exhausted the best forests of

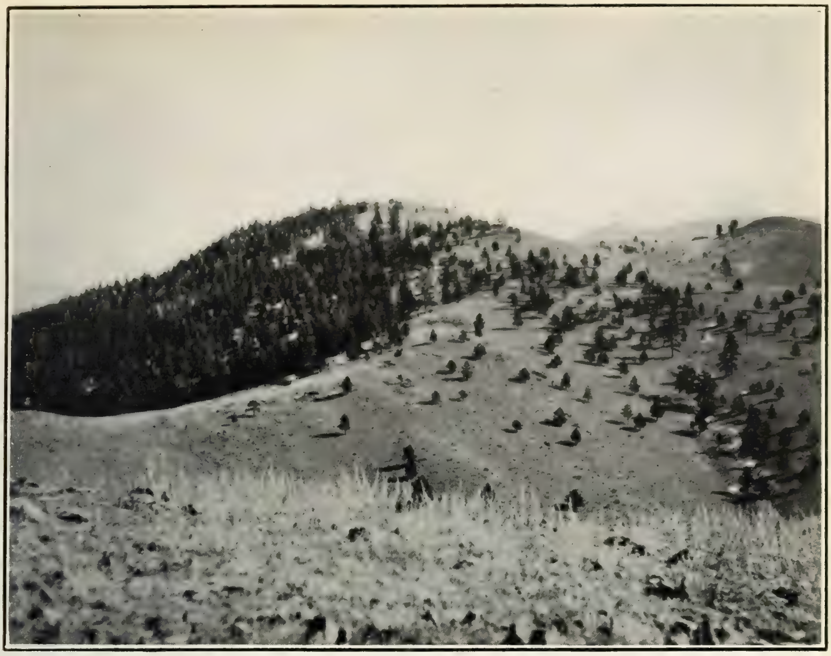

FIG. 1.—EFFECT OF SLOPE EXPOSURE.

Yellow pines (*Pinus scopulorum*) and firs (*Abies concolor*) growing at same elevation (9,000 feet) on hot and cold slopes in Wet Mountains east of Westcliffe.

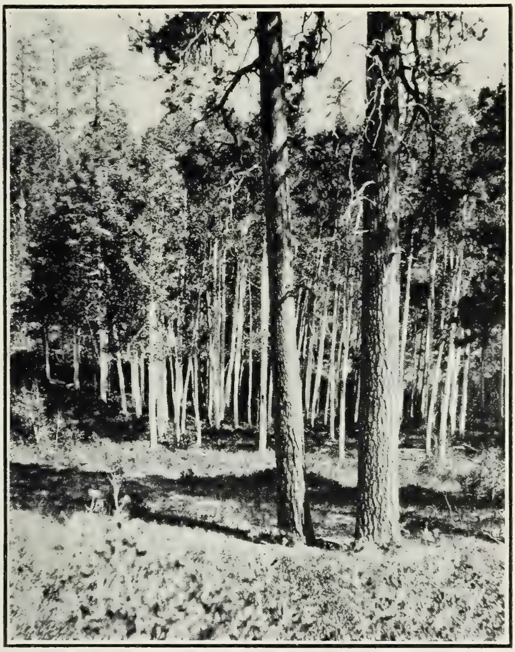

FIG. 2.—CHARACTERISTIC VIEW AT UPPER EDGE OF TRANSITION ZONE.

Undergrowth of small aspens (*Populus tremuloides*) in forest of yellow pine (*Pinus scopulorum*) on Dolores Plateau.

the region, and many stumps still remain. At present the summit and upper northern slopes of this mountain are clothed with a young and dense growth of lodgepole pines, but they apparently can not recover a foothold on the upper southwest slope, where they formerly abounded. At no other point in northern Colorado was *Pinus scopulorum* observed above 8,500 feet, and it reaches above 8.000 feet in only a few places. (Pl. VI, fig. 2.)

The Transition zone varies greatly over the State, not only in respect to its vertical and horizontal breadth, but also in its characterization, being sometimes strongly marked and again dilute and ill-defined. It is most uniform in width along the eastern flanks of the front ranges, where the chief irregularities are due to the eastward extending Arkansas Divide and the deeply penetrating valley of the Arkansas River. On the western slope of the Continental Divide the Transition belt is extremely irregular in outline, because of the many plateaus which project westward from the main ranges and the intervening desert valleys. It completely fills the upper valleys and skirts the lower valleys of the Snake, Bear, White, Grand, Gunnison, Dolores, and San Juan Rivers, and their affluents. Two independent arms of the Transition zone enter the State along its northern boundary in the intermountain region—one along the North Platte, a narrow tongue which widens to include practically all the extensive sage plains of North Park at an average elevation of about 8,000 feet; the other, a narrow strip of yellow pine and sage country in the Laramie River region. Two belts of this zone likewise penetrate the intermountain region of Colorado from the south, occupy the foothills of the San Juan and Culebra Ranges, skirt the great San Luis Valley, and connect with the upper Arkansas Transition through a narrow tongue across Poncha Pass.

As already observed, the Transition zone varies greatly in breadth. The variation in horizontal breadth, due entirely to difference in slope incline, is well illustrated by the following examples: On steep slopes such as are found north of Grand River near Glenwood Springs, and between De Beque and Rifle, the aspens of the high Canadian zone country are often less than half a mile from the junipers of the warm Upper Sonoran valley; while on the western side of the Elk Head Mountains, where the slope is very gradual, the Transition zone merges almost insensibly into the Upper Sonoran sage plains, and has a width of 8 or 10 miles or even more. Again, in a few instances, the Transition element is almost lost or crowded out by an unusual upward extension of Upper Sonoran zone. For example, on the north side of the Grand River Valley at McCoy, Eagle County, pinyons and junipers (*Juniperus monosperma*) follow up the warm south slopes to 7,800 feet, while lodgepole pines and aspens clothe the summits and northern slopes at 8,400 feet. The intervening 600 feet, or upper part of the southern slopes, supports a scattering growth of *Pinus scopulorum*, *Pseudotsuga mucronata*, *Amelanchier alnifolia*, *Symphoricarpos oreophilus*, and other Transition species.

Narrow extensions or arms of the Transition zone penetrate the mountains for a considerable distance on both sides of the main ranges, following along the warm north sides of the valleys. Under such conditions the upper limit of the yellow pines is very materially lowered where they penetrate an extensive region of high altitude—that is, the highest elevation at which the pines grow is considerably less at the head of a valley where the surrounding environment is uniformly boreal than on the slopes and ridges near the mouth of the valley, where the bordering high country is much broken and incised and thus permits a more general diffusion of warm air currents. This difference in the upward extension of the pines amounts to nearly 500 feet in the Fountain Creek Valley. In the region about Manitou the upper limit on warm slopes is approximately 9,000 feet, while at Woodland Park, in the upper valley, it is about 8,500 feet.

MAMMALS OF COLORADO TRANSITION.

Both boreal and austral mammals are represented in the Transition zone in Colorado, while only six species appear to be restricted to it. These are two squirrels of the *Sciurus aberti* group, three pocket gophers of the genus *Thomomys*, and a small brown bat, *Myotis lucifugus longicrus*. *Sciurus aberti ferreus* inhabits the eastern foothills of the front ranges from Loveland and Arkins south to the Mosca Pass region, and *Sciurus aberti mimus* occurs in the stately yellow pine forests on the southern slopes of the San Juan and La Plata Mountains. *Thomomys clusius* is found on the sage plains of North Park, on the high grassy plateau in northeastern Weld County, and on the western (higher) end of the Arkansas Divide. *Thomomys talpoides agrestis*, an isolated mountain form of the common *Thomomys talpoides* of the northern plains, is known only from the San Luis Valley meadows. Another gopher, *Thomomys fulvus*, appears to enter the State only on the Raton Mesa, in the Trinidad region. *Myotis l. longicrus* is common in the Transition zone at several points in western Colorado, and appears to be a characteristic zone species.

The following mammals, while not entirely restricted to the Transition zone, have their center of abundance there, and characterize it locally in various parts of the State: The Say chipmunk (*Eutamias quadrivittatus*), in the foothills of the eastern and southern mountains; Wyoming ground squirrel (*Citellus elegans*), on the high sage plains of North Park and in northwestern Colorado; Estes Park cliff mouse (*Peromyscus nasutus*) and Gale wood rat (*Neotoma fallax*), in the eastern foothills of the front ranges; pygmy vole (*Microtus *pauperrimus*), on the higher sage plains of North and Middle Parks and in Routt County; white-tailed jack rabbit (*Lepus campestris*), east of the Continental Divide, from North Park south to the Arkansas Divide, and in San Luis Valley; Townsend jack rabbit (*Lepus campestris townsendi*), of the higher open country west of the Continental Divide; Rocky Mountain cottontail (*Sylvilagus nuttalli pinetis*), mountain coyote (*Canis lestes*), and mountain wildcat (*Lynx uinta*), found throughout the mountainous districts; and the northern plains skunk (*Mephitis hudsonica*), which occurs on both slopes of the northern mountains.

The following mammals of wider zonal range have been found in this zone in various parts of the State:

Mammals Common to Transition and Upper Sonoran.

Antilocapra americana.
Odocoileus virginianus macrourus.
Onychomys brevicaudus.
Castor canadensis frondator.
Canis occidentalis.
Spilogale tenuis.
Eptesicus fuscus.

Mammals Common to Transition and Canadian.

Cervus canadensis.
Callospermophilus lateralis.
Eutamias amœnus operarius.
Eutamias minimus consobrinus.
Erethizon epixanthum.
Microtus nanus.
Microtus pennsylvanicus modestus.
Zapus princeps.
Vulpes macrourus.
Ursus americanus.

Mammals Common to Transition, Canadian, and Upper Sonoran.

Odocoileus hemionus.
Cynomys gunnisoni.
Cynomys leucurus.
Felis oregonensis hippolestes.
Lutreola vison energumenos.
Putorius arizonensis.
Taxidea taxus.

BREEDING BIRDS OF COLORADO TRANSITION.

Birds which breed chiefly in the Transition zone in Colorado are the sage hen (*Centrocercus urophasianus*),[1] saw-whet owl (*Cryptoglaux acadica*), sharp-shinned hawk (*Accipiter velox*), Rocky Mountain hairy woodpecker (*Dryobates villosus monticola*), Lewis woodpecker (*Asyndesmus lewisi*), Wright flycatcher (*Empidonax wrighti*), spurred towhee (*Pipilo maculatus montanus*), green-tailed towhee (*Oreospiza chlorura*), white-throated swift (*Aeronautes melanoleucus*), plumbeous vireo (*Lanivireo solitarius plumbeus*), Macgillivray warbler (*Oporornis tolmiei*), Rocky Mountain nuthatch (*Sitta carolinensis nelsoni*), pygmy nuthatch (*Sitta pygmæa*), and chestnut-backed bluebird (*Sialia mexicana bairdi*).[2] Among the birds occupying restricted areas in the Colorado Transition during the breeding season may be mentioned the Grace warbler (*Dendroica graciæ*), a common breeder in the yellow-pine forests on the southern slopes of the San Juan Mountains.

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[1] Mainly in northwestern Colorado.

[2] Southern Colorado.

Other birds conspicuous during the breeding season in the Transition belt in different parts of the State are:

Bubo virginianus pallescens.
Calamospiza melanocorys.
Colaptes cafer collaris.
Dendragapus obscurus.
Dendroica auduboni.
Euphagus cyanocephalus.
Falco sparverius phalæna.
Myiochanes richardsoni.
Oreoscoptes montanus.
Otocoris alpestris leucolæma.
Passerculus sandwichensis alaudinus.
Penthestes gambeli.
Phalænoptilus nuttalli.
Pica pica hudsonia.
Planesticus migratorius propinquus.
Poœcetes gramineus confinis.
Salpinctes obsoletus.
Sayornis saya.
Sialia currucoides.
Spizella breweri.
Spizella passerina arizonæ.
Sturnella neglecta.
Tachycineta thalassina lepida.
Troglodytes aëdon parkmani.
Vireosylva gilva swainsoni.
Xanthocephalus xanthocephalus.

Several genera of the Anatidæ and at least one genus of the Limicolæ are found on Lake John, North Park, during the summer, and doubtless breed there. These include *Branta canadensis, Anas platyrhynchos, Spatula clypeata, Querquedula discors,* and *Steganopus tricolor.* Other breeders in the same region are the coot (*Fulica americana*) and the great blue heron (*Ardea herodias*).

PLANTS OF COLORADO TRANSITION.

In Colorado, as in most sections of the western United States, the yellow pine (*Pinus scopulorum*) (see Pl. VII, fig. 2) is the characteristic Transition tree, and the zone is practically coextensive with these pines wherever they occur. Their distribution in the Colorado foothills is quite general, except in the northwest, where a very sparse and scattering growth occurs in a few widely separated localities. Over much of western Colorado north of the San Juan Mountains and Uncompahgre Plateau the Transition zone is a partially open region, sage-covered slopes and parks alternating with brushy slopes and ridges of chaparral, including such shrubs as oaks (*Quercus gambeli* (Pl. VII, fig. 1), *Q. fendleri,* and others), chokecherry (*Prunus melanocarpa*), Juneberries (*Amelanchier alnifolia, A. bakeri,* and others), and *Ceanothus velutinus, Peraphyllum ramosissimum, Symphoricarpos oreophilus, Kunzia tridentata, Cercocarpus parvifolius,* and in the Escalante Hills *Cercocarpus ledifolius.* The most prominent forest tree in the Transition belt of northwestern Colorado is the Douglas spruce (*Pseudotsuga mucronata*), which occurs chiefly on sharp declivities and on the exposed crests of the plateaus above 7,000 feet.

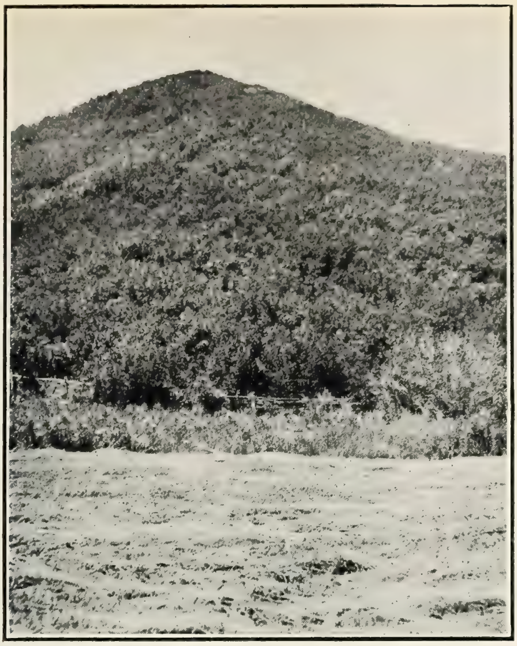

FIG. 1.—DENSE CHAPARRAL OF OAK (QUERCUS GAMBELI) IN WESTERN FOOTHILLS OF WEST ELK MOUNTAINS, ON HEAD OF SMITH FORK OF GUNNISON RIVER, ALTITUDE 8,000 FEET.

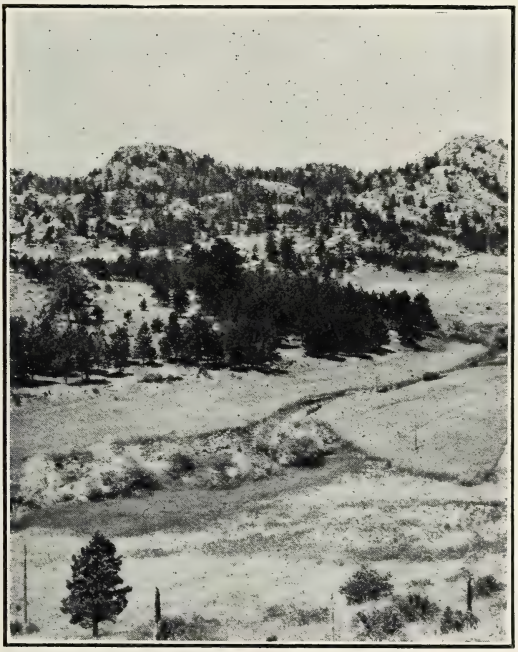

FIG. 2.—YELLOW PINES (PINUS SCOPULORUM) NEAR ELKHORN, LARIMER COUNTY, SHOWING CHARACTERISTIC SCATTERING GROWTH OF THE SPECIES ON EASTERN FOOTHILLS OF FRONT RANGE.

The vegetation of the sage plains of North Park, in addition to *Artemisia tridentata*, consists chiefly of *Sarcobatus vermiculatus* and *Chrysothamnus*, with *Kunzia tridentata* added in sandy strips of country.

Along streams throughout the State this zone is best indicated by the narrow-leaved cottonwood (*Populus angustifolia*). Some of the shrubs found commonly in the neighborhood of streams are the alder (*Alnus tenuifolia*), Rocky Mountain birch (*Betula fontinalis*), dogwood (*Svida stolonifera riparia*), hazel (*Corylus rostrata*), haws (*Cratægus saligna*, *C. wheeleri*, and others), willow (*Salix nuttalli*), *Distegia involucrata*,[1] and *Opulaster ramaleyi*. Another willow (*Salix perrostrata*) grows in dense clumps in bogs and around spring holes. A large variety of shrubs and plants are characteristic of the rocky slopes, among which are several species of June berry (*Amelanchier*), mountain holly (*Cercocarpus parvifolius*),[2] ninebark (*Opulaster monogynus*), flowering raspberry (*Oreobatus deliciosus*), New Jersey tea (*Ceanothus pubescens*), Oregon grape (*Berberis aquifolium*), bearberry (*Arctostaphylos uvaursi*), currants (*Ribes inebrians* and *R. pumilum*), *Kunzia tridentata*, *Edwinia americana*, and *Holodiscus dumosus*. A large species of bearberry (*Arctostaphylos pungens platyphylla*) forms a dense chaparral on the western slopes of the Uncompahgre Plateau and on the opposite (eastern) slopes of the La Sal Mountains, between 8,000 and 8,500 feet. The only cactuses found with any regularity in the Colorado Transition are the little *Opuntia fragilis*, which is common in the yellow pine forests near Pagosa Springs and on the Uncompahgre Plateau, and was found also along the North Fork of the Gunnison River above Somerset; the unique snake cactus (*Echinocactus simpsoni*), most abundant in the Wet Mountain Valley and adjacent region, so called because of the peculiar snake-like growth occasionally formed; and *Echinocereus viridiflorus*, also of the Wet Mountain region. *Cactus missouriensis* occurs occasionally in the yellow pine belt of the eastern foothills. *Chrysothamnus elegans*, *C. bigelovi*, and several other species of rabbit brush are common and characteristic shrubs in the Wet Mountain Valley and in all the open valleys and parks between 7,000 and 9,000 feet.

REPTILES AND BATRACHIANS OF COLORADO TRANSITION.

A few reptiles occur with more or less regularity in the Transition zone, but it is doubtful whether any are restricted to it. Among the lizards, the large gray rock lizard (*Sceloporus elongatus*)[3] is found in rocky situations along the lower edge of the zone in many parts of western and southwestern Colorado. One of the whip-tailed lizards,

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[1] Also lower Canadian. [2] Also Upper Sonoran. [3] Most abundant in Upper Sonoran zone.

(*Cnemidophorus gularis*)[1] seen in the foothills near Golden in June, 1905, was in a rank growth of grass on a yellow pine slope, at 6,500 feet. Horned toads (*Phrynosoma ornatissimum*) are tolerably common in the sandy yellow pine country on the northern end of the Uncompahgre Plateau. In July, 1907, several were seen on the head of Dominguez Creek, at 8,500 feet, and one individual was collected. Another, not over a third grown, was taken in late September, 1906, at the same elevation on the chaparral-covered summit of the Book Cliffs at Baxter Pass near the Utah boundary. A garter snake (*Thamnophis elegans vagrans*)[2] is not uncommon in the pine belt and is found also in the lake region of North Park. A specimen taken at Higho, North Park, in August, 1906, was crawling through the sagebrush at some distance from water. Another was collected along Snake River east of Slater, Routt County, in August, 1906, at a little over 7,000 feet. The little green snake (*Liopeltis vernalis*) was taken but once, on the bank of the Rio Piños, a few miles below Vallecito, June 6, 1907. A small frog (*Chorophilus triseriatus*) was secured on Snake River, about 10 miles east of Slater, August 21, 1906. Edward A. Preble collected the larva of a salamander (*Ambystoma tigrinum*) in Estes Park in 1895.

AGRICULTURAL IMPORTANCE OF THE TRANSITION ZONE.

The rough and broken character of much of the Transition area in Colorado precludes agriculture on an extensive scale, although the climatic conditions are favorable for many of the hardier vegetables, cereals, and fruits. The most important of its natural resources are the yellow pine forests, which in some localities are very extensive. The few areas of any size which are sufficiently open for cultivation are North Park, the Wet Mountain Valley, San Luis Valley, and the western (higher) end of the Arkansas Divide, together with certain of the larger foothill valleys. Of these, the first two are devoted largely to ranching and hay raising, the Arkansas Divide to grazing, and the San Luis Valley alone to extensive agriculture. Wheat, oats, and rye are the leading cereals raised in the Colorado Transition, while timothy is an important hay crop. A great deal of alfalfa is grown along the lower edge of the zone, where it usually yields two cuttings. Higher up it is not a success. Potatoes and Canada field peas are important crops in the San Luis Valley. A great variety of vegetables are grown in the San Luis Valley, and also in the stream valleys of the higher foothills over the State, where a good market is furnished by the neighboring mining camps. Comparatively little fruit is raised, but with a proper selection of hardy varieties horticulture might be made an important industry in the protected foothill

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[1] Most abundant in Upper Sonoran zone.

[2] Also in lower Canadian zone.

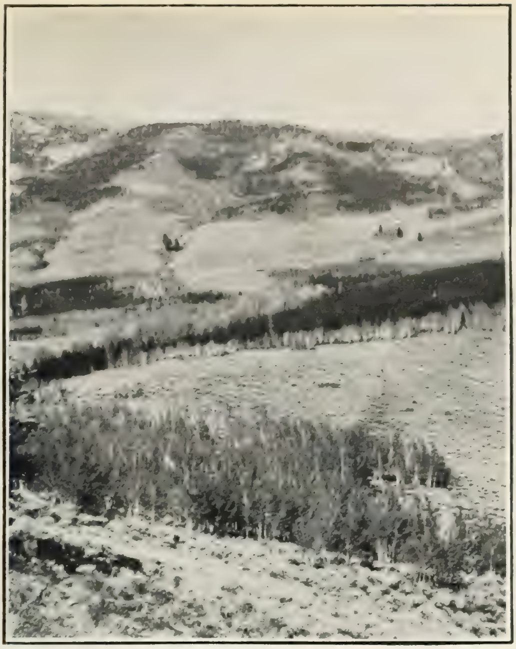

FIG. 1.—LOWER PART OF CANADIAN ZONE FOREST OF LODGEPOLE PINES (PINUS MURRAYANA) AND ASPENS (POPULUS TREMULOIDES) ON NORTH PARK SLOPE OF MEDICINE BOW RANGE.

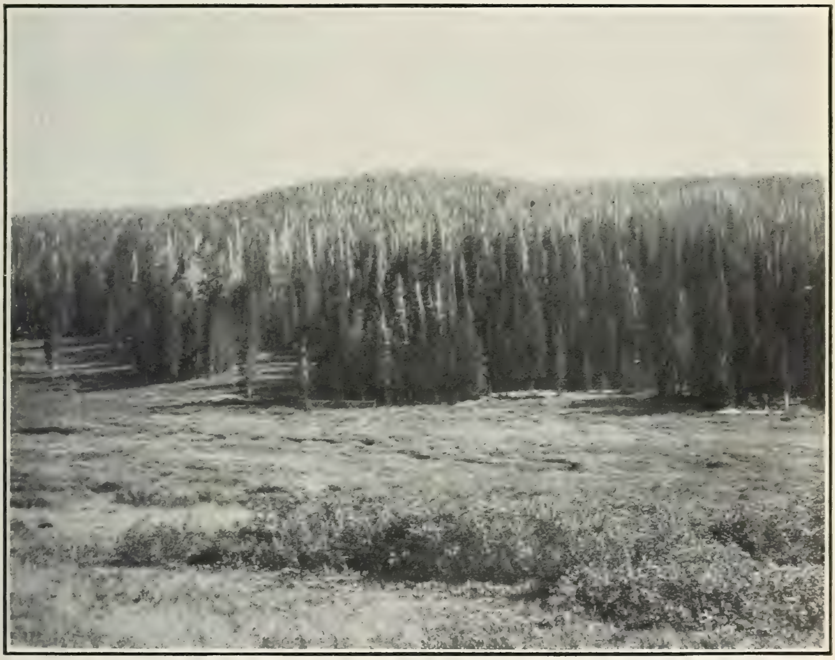

FIG. 2.—FOREST OF ENGELMANN SPRUCE (PICEA ENGELMANNI) IN UPPER PART OF CANADIAN ZONE, ON SUMMIT OF PARK RANGE, AT 10,000 FEET.

valleys wherever water is available for irrigation. A variety of berry fruits, such as June berries, strawberries, raspberries, currants, and gooseberries, are native to the Transition zone in Colorado.

The Transition zone is suited to the growth of practically all the vegetables, including the cabbage, lettuce, turnip, radish, potato, beet (both table and sugar), pea, bean, onion, carrot, parsnip, and early sweet corn; all hardy cereals; and the hardier varieties of apples, cherries, and small fruits. The crab apple reaches its best development in this zone.[1]

CANADIAN ZONE.

This, the more extensive of the boreal zones, occupies the middle slopes on the main ranges and extensive areas in the mountain parks, and caps all of the higher western plateaus, thus including the larger part of the coniferous forests of the State. Broadly speaking, the Canadian zone is characterized in the mountains of Colorado by extensive forest belts of aspens (*Populus tremuloides*), lodgepole pines (*Pinus murrayana*), and the lower, heaviest part of the Engelmann spruce belt (see Pl. VIII, fig. 2). White firs (*Abies concolor*) are added to these in the southern mountains. On the western plateaus it is marked by either a mixed forest of aspens and Engelmann spruces, or else a partially open country of grassy parks and aspen groves. In the park region of central Colorado considerable areas of open grass land are in this zone.

Chief among the elevated areas in western Colorado extensively capped with Canadian zone are the White River, Book, and Uncompahgre Plateaus; Grand, Battlement, Lone, and Blue Mesas; the Danforth and Huntsmans Hills; and the Cathedral Bluffs. The Gore, Elk Head, Rabbit Ear, Williams River, and West Elk Mountains are largely or wholly Canadian, while perhaps the largest areas of this zone are found in the Middle, Egeria, and South Park regions. Small Canadian zone islands cap the summits and upper northern slopes of many small outlying peaks and plateaus, especially in western and southern Colorado. Among these may be mentioned Diamond and Zenobia Peaks, Mount Cullom, and Yampa and O-wi-yu-kuts Plateaus, all in extreme western Routt County; Ute Peak, the highest point in the Sierra el Late, in Montezuma County; isolated table mountains south of the San Miguel and San Juan Mountains, and peaks between the upper forks of the South Platte; and Raton Mesa, southeast of Trinidad.

In the mountains of the northern half of the State the lodgepole pine and aspen forests are regularly entered at between 7,500 and 8,000 feet, and continue up to a little over 10,000 feet. (See Pl.

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[1] Some of the varieties of cereals and fruits which have proved adapted to the Transition zone (arid subdivision) in Idaho, eastern Washington, and Utah, are listed by Merriam in Life Zones and Crop Zones, Bull. No. 10, Biological Survey, pp. 25–27, 1898.

VIII, fig. 1.) Passing south to the latitude of Colorado Springs, the Canadian zone level is raised 500 to 1,000 feet, and continues high over most of the southern mountains, with the vertical breadth about as in the north. The vertical boundaries are subject to great local variation, according to physiographic conditions, entirely apart from the regular elevation and depression due to slope exposure. Striking examples are the upper Arkansas Valley and Gunnison regions, on opposite sides of the Continental Divide. On the mountain slopes bordering the upper Arkansas from the Royal Gorge to Buena Vista and beyond, Canadian zone species are seldom encountered much below 8,500 or 9,000 feet, even on cold exposures, and along the east side of the valley in the vicinity of Trout Creek Pass they are crowded on warm slopes above 9,500 feet. Over much of the upper Gunnison country lodgepole pines and aspens grow regularly as low as 8,000 feet on cold exposures and 8,500 feet on warmer slopes. The comparatively low elevation reached in the Gunnison country is undoubtedly due to the influence of the great mass of boreal country which practically surrounds the region. The unusually high temperature and consequent high zone levels which prevail in the upper Arkansas region are probably due to several factors. The southward trend of this narrow valley admits the hottest rays of the sun, which shine with great directness upon very abrupt bordering slopes; while the region to the east and south is neither so high nor so extensively boreal as that which surrounds the Gunnison country. The western slopes of the Sangre de Cristo Range and the eastern slopes of the Cochetopa Hills and Garita Mountains, bordering the northern two-thirds of the San Luis Valley, and the eastern slopes of the Sangre de Cristo Range near Mosca and Sand Hill Passes, are other notable examples of abnormally high zone levels, where on warm slopes the Canadian element is often forced above 9,500 feet. This is probably the result of the high, 7,500-foot base level of San Luis Valley. South from Mosca Pass along the eastern slope of the range the lower boundary of the Canadian zone gradually drops to about 8,000 feet, which level is uniformly maintained on the slopes of the high Culebra Range west of Trinidad. The low 6,000-foot base level of the Trinidad plains would account for low zone levels on the Culebras.

The effect of slope exposure on zone level is well shown along the lower edge of the Canadian zone, both on individual slopes and on opposite sides of mountain ranges, especially on those which rise abruptly with few flanking foothills. On the high narrow Sangre de Cristo Range the difference in mean elevation between the east and west slopes amounts to fully 500 feet, and it is nearly as great on some of the other ranges. Throughout the mountains, cool shaded north and northeast slopes and gulches carry the aspens, lodgepole

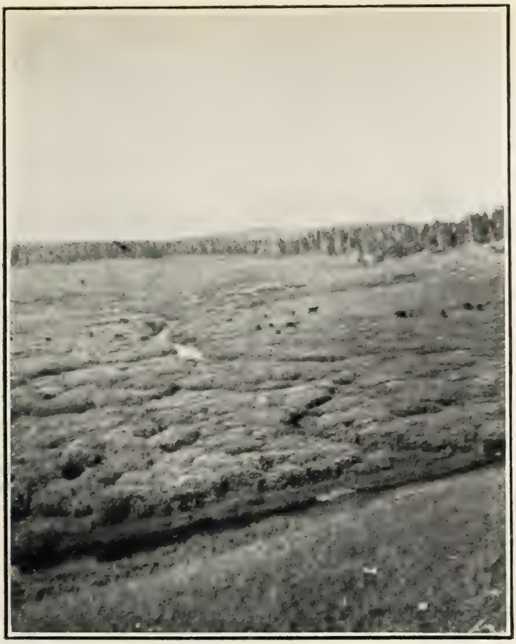

FIG. 1.—SUMMER CATTLE RANGE, CANADIAN ZONE MEADOW EAST OF LARAMIE RIVER, 10,000 FEET ALTITUDE.

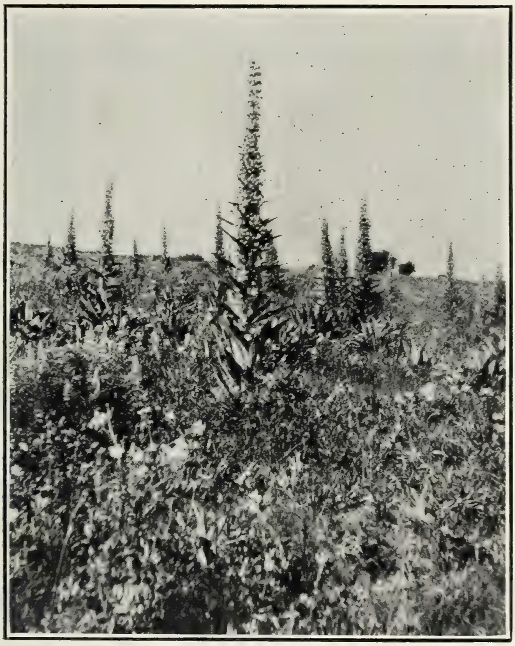

FIG. 2.—CANADIAN ZONE VEGETATION AT 9,000 FEET ON OPEN SUMMIT OF UNCOMPAHGRE PLATEAU—FRASERA, DELPHINIUM, GERANIUM, AND LUPINUS.

pines, firs, and other Canadian zone vegetation to a low elevation. Some of the cold streams on the eastern slope of the Front Range carry quite pronounced tongues of Canadian zone as low as 7,000 feet. These consist of thickets of aspens, a scattering fringe of blue spruces (*Picea parryana*), and occasionally an Engelmann spruce. These descending boreal tongues are invariably embraced by warm slopes clothed in different parts of the State with yellow pines, oaks, sagebrush, and other Transition zone vegetation. At Honnold, Routt County, lodgepole pines and dense thickets of scrubby aspens crowd down the steep northern faces of the Elk Head Mountains to the bank of Snake River, at 7,000 feet, alternating with ascending tongues of sagebrush (*Artemisia tridentata*) on all the warm Transition slopes up to 7,500 or even 8,000 feet.

The boreal forest belts are best shown on sharply inclined slopes, like the steep north side of the Clear Creek Valley between Silver Plume and Graymont, where in summer a beautiful tricolored appearance is presented, due to the three shades of green of the aspen, lodgepole pine, and Engelmann spruce forest. The slopes up to 10,500 feet are densely clothed with the first two trees in about equal abundance, and present a patched appearance, thickets and ascending tongues of the light-green aspens being scattered through the more uniformly distributed, dark, yellowish-green pines. (See Pl. VIII, fig. 1.) Joining the upper edge of this forest is a regular and well-marked belt of greenish-black Engelmann spruces, while still higher up the slope may be seen the straggling growth of foxtail pines (*Pinus aristata*) of the timberline region—of the same hue as the Engelmann spruces, but distinguishable by their ragged appearance.

In Colorado extensive forests cover a very large percentage of the total area occupied by the Canadian zone, which is poorly adapted to crops. The only open land at all suited to agriculture is found along the lower edge, between 8,000 and 9,000 feet, and comprises narrow strips along the streams in the larger mountain valleys and parks and on the western plateaus. At present this agricultural land is largely utilized for wild hay and timothy. As most of the park and plateau region supports a luxuriant growth of grasses, affording an excellent summer range for cattle (see Pl. IX, fig. 1), there would probably be no economic advantage in cultivating the hardy cereals grown in the warmer part of this zone in various sections of the United States and Canada. A very limited acreage of rye, oats, and wheat is grown in Middle Park and elsewhere in the mountains, but as yet their culture is scarcely beyond the experimental stage. The hardier vegetables also, as beets, parsnips, lettuce, turnips, potatoes, cabbages, and carrots, are raised successfully along the lower edge of the zone. The fact that wild strawberries, raspberries, currants, and blueberries grow in profusion in this zone strongly suggests that cultivated varieties might do well in favored spots. The roughness of much of the region in this zone precludes the possibility of extensive agriculture even under favorable climatic conditions. The chief resource of the Canadian zone, however, is its timber, especially the extensive forests of lodgepole pines. On some of the northern mountains, as the Park and Medicine Bow Ranges, where mining operations have made the least inroad on the forests, these pines grow very closely and to maximum size, many of the trees reaching a diameter of 2 feet or more. With their remarkably uniform straight growth and close stand, these pines form a beautiful and stately forest and yield valuable lumber. (See fig. 31.)

MAMMALS OF COLORADO CANADIAN ZONE.

The following boreal mammals have their center of abundance in the Canadian zone of Colorado, and rarely range much lower, although most of them extend up into the Hudsonian zone: Fremont chickaree (*Sciurus fremonti*), woodchuck (*Marmota engelhardti*), Rocky Mountain red-backed mouse (*Evotomys gapperi galei*), Preble phenacomys (*Phenacomys preblei*), mountain phenacomys (*Phenacomys orophilus*), Rocky Mountain field mouse (*Microtus mordax*), tawny white-footed mouse (*Peromyscus maniculatus rufinus*), snowshoe rabbit (*Lepus bairdi*), Colorado pocket gopher (*Thomomys fossor*), black bear (*Ursus americanus*), western fox (*Vulpes macrourus*), Rocky Mountain jumping mouse (*Zapus princeps*), dwarf weasel (*Putorius streatori leptus*), Canada lynx (*Lynx canadensis*), marten (*Mustela caurina origenes*), wolverine (*Gulo luscus*), shrews (*Sorex vagrans dobsoni, S. tenellus nanus, S. obscurus*, and *S. personatus*), water shrew (*Neosorex palustris navigator*), and silver-haired bat (*Lasionycteris noctivagans*).

BREEDING BIRDS OF COLORADO CANADIAN ZONE.

The following birds appear to be very commonly found in the Canadian zone in Colorado during the breeding season: Rocky Mountain jay (*Perisoreus canadensis capitalis*), olive-sided flycatcher (*Nuttallornis borealis*), Alpine three-toed woodpecker (*Picoides americanus dorsalis*), Lincoln sparrow (*Melospiza lincolni*), *Dendragapus obscurus, Cyanocitta stelleri diademata, Loxia curvirostra minor, Sphyrapicus thyroideus, S. varius nuchalis, Spinus pinus, Junco phæonotus caniceps, Iridoprocne bicolor, Sitta canadensis, Cinclus mexicanus unicolor, Myadestes townsendi, Hylocichla guttata auduboni, Dendroica auduboni*, and *Carpodacus cassini*. Some of the above species breed more or less commonly from the foothill region nearly to timberline, but their center of abundance during the breeding season is in the Canadian zone, between 8,000 and 10,000 feet.

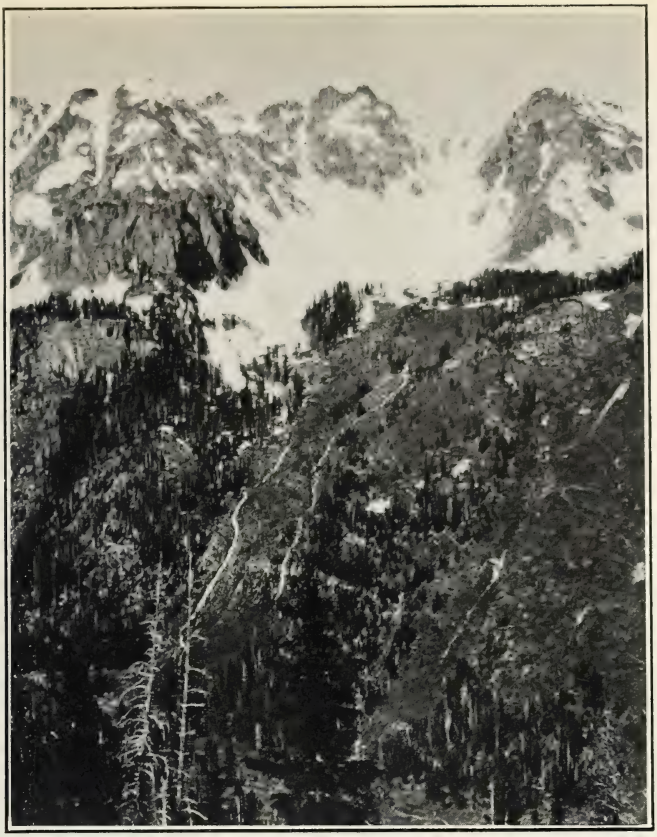

FIG. 1.—HUDSONIAN ZONE, SAN JUAN MOUNTAINS, SOUTHWEST OF OPHIR.

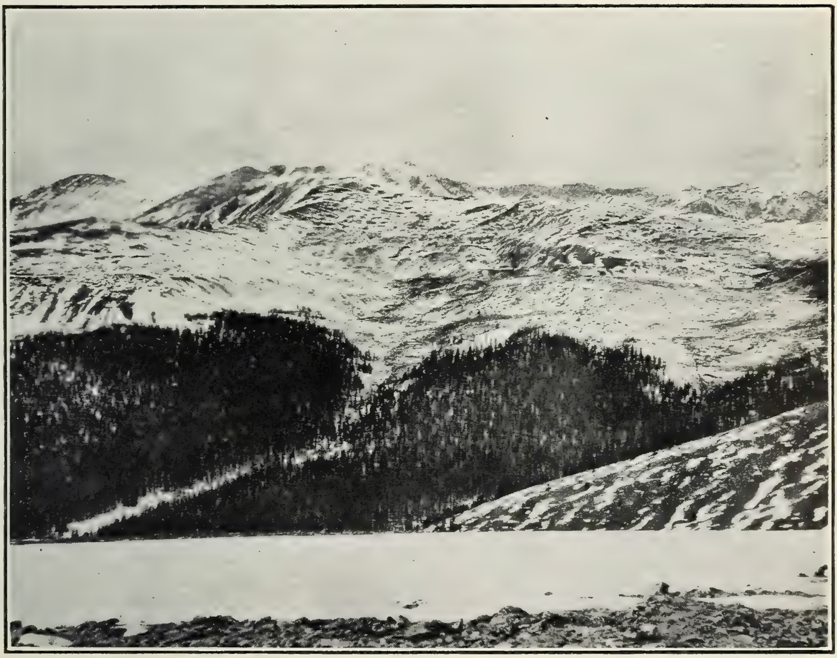

FIG. 2.—HUDSONIAN ZONE FOREST ON SAGUACHE RANGE NEAR ST. ELMO (12,000 FEET.)

PLANTS OF COLORADO CANADIAN ZONE.

The coniferous forest of the Canadian zone is composed chiefly of lodgepole pines in the northern two-thirds of the State and of white firs in the southern third; but it includes also the heaviest and lowest part of the Engelmann spruce belt and a scattering growth of balsam firs (*Abies lasiocarpa*) along its upper edge; and in the lower third a fringe of blue spruce along the streams, more or less Rocky Mountain white pine (*Pinus flexilis*), especially in the southern mountains, and an admixture of Douglas spruce along its lower edge throughout the State. The aspen (*Populus tremuloides*) marks this zone in all the mountainous sections.

The most characteristic shrubs and plants are the Canadian buffalo berry (*Lepargyrea canadensis*) on dry slopes, chiefly of the Front, Park, and Saguache Ranges; alder (*Alnus tenuifolia*), and willows (*Salix geyeriana* and others), which fringe the cold streams and bogs between 10,000 and 11,000 feet; elderberries (*Sambucus melanocarpa* and *S. microbotrys);* blueberry (*Vaccinium caespitosum);* currant (*Ribes wolfi);* mountain juniper (*Juniperus sibirica);* mountain maple (*Acer glabrum);* columbine (*Aquilegia cærulea);* twinflower (*Linnæa americana); Pachystima myrsinites; Rubacer parviflorus; Viburnum pauciflorum; Viola canadensis neomexicana; Frasera speciosa* (see Pl. IX, fig. 2); *Cytherea bulbosa; Actæa viridiflora; Dasiphora fruticosa; Rosa manca;* and several species of *Pyrola, Epilobium, Castilleja,* and *Delphinium.* The little dwarf birch (*Betula glandulosa*) forms a conspicuous fringe along cold streams and bogs in the upper part of the zone in many of the mountain ranges.

REPTILES OF COLORADO CANADIAN ZONE.

The only reptile observed in this zone is a garter snake (*Thamnophis elegans vagrans*), collected in a cold bog near Pearl, North Park, in August, 1906, at an altitude of a little over 8,000 feet. It is not known, however, that this snake occurs regularly in the Canadian zone. It is not uncommon over the State in the Transition zone.

HUDSONIAN ZONE.

On all the higher mountains of Colorado a dark, somber-colored forest belt of varying width is prominent just below timberline. Traced along the upper slopes of the main ranges this belt is seen to be heaviest and broadest in gulches and basins, while on jutting shoulders and exposed ridges of steep incline it often contracts to a narrow black line. (See Pl. X, fig. 1.) This is the upper forest of Engelmann spruce (*Picea engelmanni*) and balsam fir (*Abies lasiocarpa*), and marks in a general way the limits of the Hudsonian zone. It is a neutral or transition area combining both Arctic-Alpine and Canadian zone elements. Very few species are restricted to it, and it is therefore not so well characterized as either bordering zone.

Especially is this lack of character manifest along the lower edge of the zone, where in the heavy forests on slopes of moderate incline Hudsonian conditions merge almost insensibly into those of the Canadian zone. Well-defined belts of the Hudsonian zone are found only on such mountain ranges as are sufficiently high to afford alpine conditions on their summits and highest spurs, as the Front, Park, Saguache (see Pl. X, fig. 2) and Sangre de Cristo Ranges, and the San Juan Mountains. The lower stretches of the above ranges and many connecting and outlying mountains with a near approach to timberline conditions on their highest elevations are capped with this zone. In dilute form it may be traced also along the crests of some of the outlying ridges and spurs which do not reach timberline.

The vertical width of the Hudsonian zone on the Colorado mountains is not far from 1,000 feet. It narrows to 600 feet in places, and again widens to as much as 1,200 feet, and in extreme cases to 1,500 feet. The lower boundary is seldom clearly defined, being usually on steep slopes at between 10,500 feet and 10,800 feet on warm exposures, and several hundred feet lower on cool slopes and especially in gulches. The upper part of the Hudsonian belt is well indicated by timberline conditions. On normal warm slopes the spruces and firs begin to dwarf at a little over 11,000 feet. They rapidly become stunted and much dwarfed, then semiprostrate, and finally as dense prostrate mats from 1 to 3 feet in height and often many feet in diameter, crowd far up the exposed ridges in narrow ascending tongues, giving place to the bare Alpine slopes at a mean elevation of about 11,500 feet, but on the warmest slopes from 11,800 feet to 12,300 feet.

The upper limit of this zone (timberline) is the best marked of all zonal boundaries. It is very sinuous, and affords perhaps the most striking example of one zone lapping past another. Traced along the upper slopes of a mountain range, it is seen regularly to dip down several hundred feet to skirt the lower edges of basins and gulches occupied by descending arms of the Arctic-Alpine zone; and again to reach far above its normal elevation on the exposed crests of the bordering ridges. In this manner tongues of Arctic-Alpine and Hudsonian zone regularly lap past each other at timberline for a vertical distance of 400 or 500 feet and in extreme cases for twice that distance, or about the width of the zone. (See Pl. XI, fig. 2.)

The following are a few of the limits of the Hudsonian zone in different parts of the State that will serve to illustrate the range of variation as to vertical position: Rollins Pass, Front Range (east slope), 10,000 to 10,900 feet; near Fremont Pass (east slope), 11,000 to 11,600 feet; St. Elmo, Saguache Range (southwest slope), 10,800 to 12,300 feet; Ophir, San Juan Mountains (north slope), 10,500 to 11,500 feet; Continental Divide, southeast of Lake City (northwest slope), 10,800 to 12,000 feet.

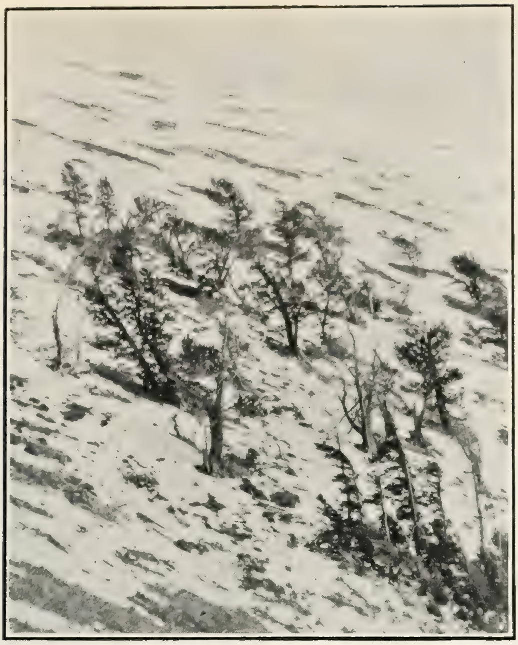

FIG. 1.—FOXTAIL PINES (PINUS ARISTATA) AT TIMBERLINE NEAR ST. ELMO, SAGUACHE MOUNTAINS, AT 12,300 FEET.

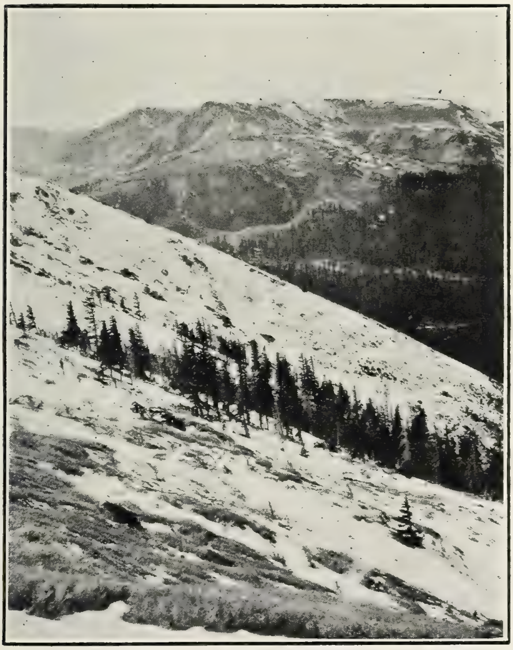

FIG. 2.—ASCENDING TONGUE OF ENGELMANN SPRUCE AT TIMBERLINE ON FRONT RANGE NEAR BERTHOUD PASS (NORTHWEST SLOPE), AT 11,600 FEET.

The Engelmann spruce predominates in the Hudsonian forest belt throughout Colorado, and in certain sections is the only tree present. Usually, however, thickets of balsam fir are scattered through the spruce forest in bogs and on cool slopes, and occasionally the firs form a dense growth, as on the eastern slope of the Front Range in the vicinity of Rollins Pass, on the western slope of the same range above Arrow and Idlewild, and west of Alpine Pass on the Saguache Range. Both the spruce and fir extend up to extreme timberline. They reach their maximum size, and the former its densest growth, along the upper edge of the Canadian zone. Above 11,000 feet dwarfed growth is the rule, but there are marked exceptions. In crossing the two high ridges which form the divide between the Lake Fork of the Gunnison and Cebolla Creek, southeast of Lake City, at elevations of 11,350 and 11,550 feet, respectively, I found the spruce belt continuous and heavy, the trees averaging from 60 to 80 feet in height. On a southwest slope in the Saguache Mountains north of St. Elmo, at an altitude of 11,700 feet, Engelmann spruces were growing commonly to a height of 30 or 40 feet.

On the Front Range south of James Peak, throughout the length of the Saguache Range, and on the Sangre de Cristo Range south at least to Crestone Peak, another tree occupies much of the timberline region to the partial exclusion of the spruce and fir This is the foxtail pine (*Pinus aristata*), which crowds up the warm sides and along the crests of exposed gravelly ridges in a ragged, one-sided, wind-beaten growth from 5 to 15 feet in height. This pine appears to be local in its distribution, being present on some mountains and entirely absent on neighboring peaks of the same range. It is largely confined to the front ranges south of the latitude of Denver and was not noted on the mountains of western and extreme northern Colorado. It is the characteristic timberline tree on the mountains bordering South Park on the west, and also on that part of the Saguache Range known as the University Range—from Salida north to Buena Vista. Warm south and southwest slopes are chiefly occupied by the foxtail pines. Timberline on the cool sides of the mountains is usually formed by spruces and firs. But at St. Elmo, where foxtail pines form the highest recorded timberline in the State (12,300 feet), the gnarled and twisted, often nearly prostrate, trunks of the uppermost of these evidence in a most striking manner the stern contest for existence waged against a rigorous and adverse climate. (See Pl. XI, fig. 1.)

Although characteristic of the Hudsonian zone, the Engelmann spruce, balsam fir, and foxtail pine are by no means restricted to it. The spruce forms regularly a heavy growth and the fir a scattering growth along the upper edge of the Canadian zone, while the pine occurs sparingly on exposed gravelly points and ridges as low as 9,500 feet, particularly in the South Park region.

The mossy floor of the Hudsonian forest is saturated with moisture throughout the summer from the melting snows of the higher slopes, and cold bogs abound. Flowering plants grow in profusion, although the number of species is not large—the flora being mostly a mixture of overlapping Arctic-Alpine and Canadian zone species.

The Hudsonian and Arctic-Alpine regions are not only the sources, but also the conservers, of much of the water supply, so vitally essential to successful agriculture throughout the State, and the importance of the regions in this regard can scarcely be overestimated. The forests of Engelmann spruce and balsam fir, although yielding lumber of very inferior quality, are used extensively for mining timbers in the higher mountains.

MAMMALS OF COLORADO HUDSONIAN ZONE.

Among mammals, no species appears to be restricted to the Hudsonian, but the pika, marmot, and mountain sheep are characteristic of the timberline region.

The following are found in greater or less abundance, as either residents or stragglers:

Callospermophilus lateralis.
Canis lestes.
Cervus canadensis.
Erethizon epixanthum.
Eutamias amœnus operarius.
Eutamias minimus consobrinus.
Evotomys gapperi galei.
Felis oregonensis hippolestes.
Gulo luscus.
Lepus bairdi.
Lepus campestris townsendi.
Lynx canadensis.
Lynx uinta.
Marmota engelhardti.
Microtus mordax.
Microtus nanus.
Mustela caurina origenes.
Neotoma cinerea orolestes.
Ochotona saxatilis.
Odocoileus hemionus.
Ovis canadensis.
Peromyscus maniculatus rufinus.
Putorius arizonensis.
Putorius streatori leptus.
Sciurus fremonti.
Sorex obscurus.
Thomomys fossor.
Ursus americanus.
Ursus horribilis.
Vulpes macrourus.

BREEDING BIRDS OF COLORADO HUDSONIAN ZONE.

The following birds are restricted mainly in their breeding range to the Hudsonian zone: *Pinicola enucleator montana*, *Certhia familiaris montana*, and *Regulus satrapa*.

The following birds occur commonly in summer in Hudsonian and Canadian zones, some of them breeding early in a lower zone:

Picoides americanus dorsalis.
Nucifraga columbiana.
Perisoreus canadensis capitalis.
Myadestes townsendi.
Zonotrichia leucophrys.
Junco phæonotus caniceps.
Spinus pinus.
Wilsonia pusilla pileolata.
Regulus calendula.
Hylocichla guttata auduboni.
Planesticus migratorius propinquus.
Sialia currucoides.
Colaptes cafer collaris.

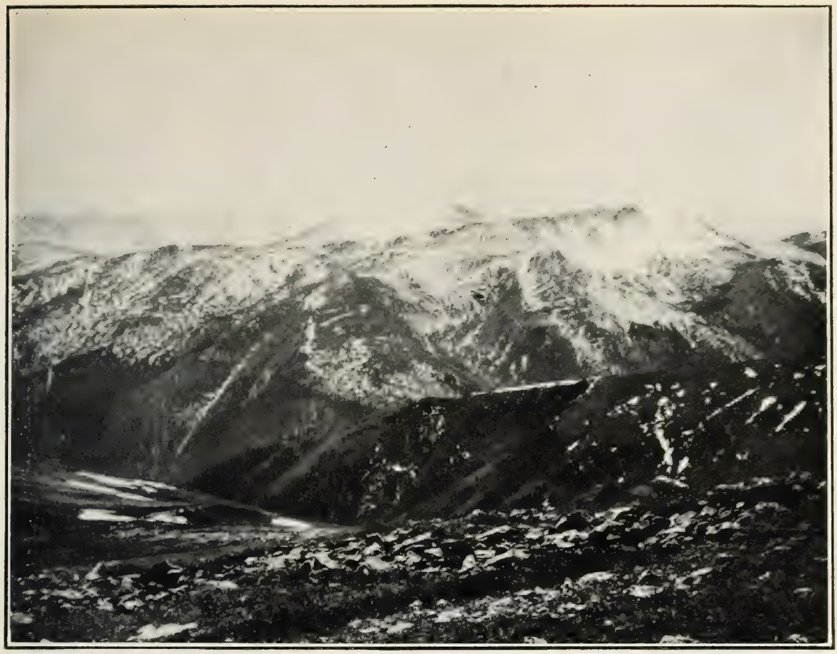

FIG. 1.—GRAYS PEAK GROUP FROM NEAR BERTHOUD PASS, SHOWING AN EXTENSIVE AREA OF ARCTIC-ALPINE COUNTRY.

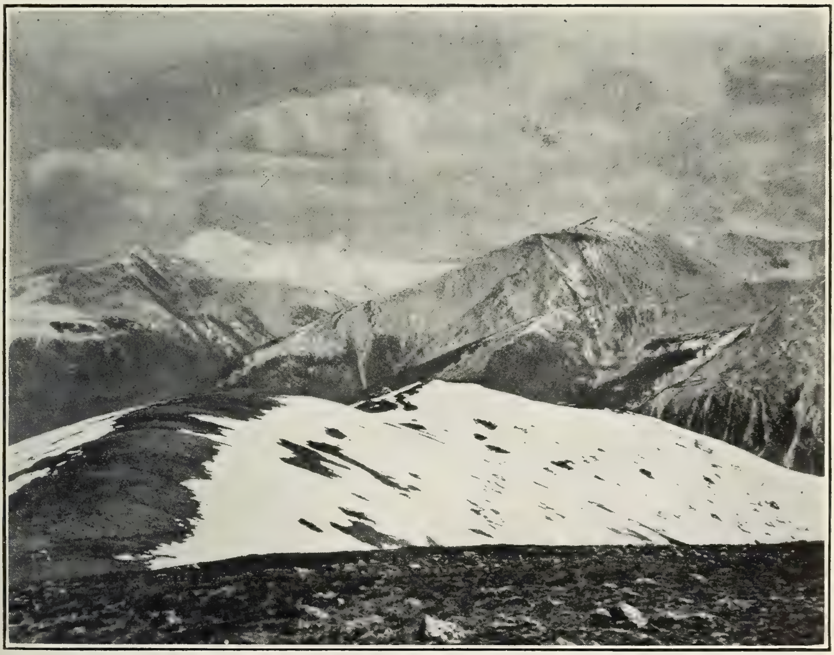

FIG. 2.—ARCTIC-ALPINE ZONE ON THE SAGUACHE RANGE NEAR ST. ELMO.

PLANTS OF COLORADO HUDSONIAN ZONE.

The distribution of the Engelmann spruce (*Picea engelmanni*), balsam fir (*Abies lasiocarpa*), and foxtail pine (*Pinus aristata*) in the Hudsonian zone has already been discussed in detail. Conspicuous plants and shrubs of the timberline region are: *Caltha leptosepala*, *Trollius albiflorus*, *Ranunculus unguiculatus*, *Erysimum radicum*, *Sedum stenopetalum*, *Polemonium* (several species), *Trifolium* (several species), *Androsace* (several species), *Clementsia rhodantha*, *Rhodiola polygama* and *R. integrifolia*, *Mertensia alpina* and other species, *Epilobium*, *Vaccinium erythrococcum*, *Kalmia microphylla*, *Betula glandulosa*, *Salix glaucops*, *S. pseudolapponum*, *S. chlorophylla*, and *S. saximontana*.

ARCTIC-ALPINE ZONE.

Truly arctic conditions characterize this zone, which occupies the summits of the highest peaks and the crests of all the higher mountains above the limit of tree growth. Small areas are found on the Park Range from Buck Mountain and Mount Zirkel south nearly to Buffalo Pass; on the southern half of the Medicine Bow Range; on the higher eastern end of the Rabbit Ear Mountains; and on the Vasquez, Williams, and Gore Mountains of the Middle Park region. A belt which is continuous, or at most is broken only by narrow gaps dipping to timberline or a trifle below, extends from Longs Peak south along the crest of the Front Range to Grays Peak (see Pl. XII, fig. 1) and the Leadville region. Extensive areas of the Arctic-Alpine zone are found on the mountains of southern Colorado, especially on the San Juan Mountains, and on the Saguache (see Pl. XII, fig. 2), Sangre de Cristo, and Culebra Ranges. The La Plata, San Miguel, Elk, Tarryall, and Wet Mountains, and the Kenosha Range all have many summits reaching far above timberline. Small islands of the Arctic-Alpine zone also cap many of the more or less isolated peaks of the Gunnison country, Pikes Peak, and a few of the highest elevations at the eastern end of the White River Plateau known collectively as the Flat Top Peaks.

The altitude of extreme timberline, which marks the lower boundary of the Arctic-Alpine zone, varies over the State according to slope, exposure, and latitude from a trifle under 11,000 feet to 12,300 feet. It is lowest in the northern mountains and in the San Juans,[1] where the mean elevation is 11,500 feet and the extremes are 10,900 feet (east side of Rollins Pass and south of Ophir), and 11,800 feet (mountains southeast of Lake City); and highest on the Front and Saguache Ranges west of South Park and the Arkansas Valley, with a mean elevation of nearly 11,800 feet, and extremes of 11,000 feet and 12,300 feet (north of St. Elmo). Under normal conditions the Arctic-Alpine zone usually dips lowest in basins and gulches with northeast exposures, where it is often embraced for 500 feet or more by ascending tongues of the Hudsonian zone, which follow up the bordering ridges. The exceptional cases, where timberline is lowest on west or southwest slopes, will usually be found to be due to unnatural conditions. Thus at Boreas Pass, in the mountains west of South Park, timberline is below 11,600 feet on a southwest slope of slide rock, while on the northeast slope opposite, with favorable soil conditions, it reaches 11,900 or 12,000 feet. In approximating the elevation of normal timberline due allowance must always be made for the effects of rock slides and avalanches, which, viewed from a distance, appear to be descending tongues of Arctic-Alpine zone reaching far below timberline. These slides, by carrying away the soil and leaving in its place great masses of slide rock, create conditions unsuitable for tree growth, yet do not remove the climatic barrier which prevents the downward dispersion of Alpine species.

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[1] The reason for the low average timberline elevations in the San Juan Mountains is the lowness of the base level (5,000 feet), where their latitude and their proximity to a hot desert region on the west would lead us to expect a high timberline.

The Arctic-Alpine area is a bare and bleak region covered with snow for the greater part of the year, and with more or less remaining on the ground in summer. Naturally the variety of life is here reduced to a minimum.

MAMMALS OF COLORADO ARCTIC-ALPINE ZONE.

No mammals are restricted to the Arctic-Alpine area in Colorado. The following species range at times to considerably above timberline in different parts of the mountains: Mountain sheep (*Ovis canadensis*), grizzly bear (*Ursus horribilis*), coyote (*Canis lestes*), marten (*Mustela caurina origenes*), western fox (*Vulpes macrourus*), porcupine (*Erethizon epixanthum*), snowshoe rabbit (*Lepus bairdi*), two chipmunks (*Eutamias amœnus operarius* and *E. minimus consobrinus*), marmot (*Marmota engelhardti*), Colorado pocket gopher (*Thomomys fossor*), pika (*Ochotona saxatilis*), and two field mice (*Microtus mordax* and *M. nanus*). Of these the marmot, pika, pocket gopher, and field mice apparently live in this bleak region throughout the year.

BREEDING BIRDS OF COLORADO ARCTIC-ALPINE ZONE.

Three species of birds are restricted to the Alpine zone during the breeding season. These are the white-tailed ptarmigan (*Lagopus leucurus*), the pipit (*Anthus rubescens*), and the brown-capped rosy finch (*Leucosticte australis*), none of which are known to breed much below 12,000 feet. The pileolated warbler (*Wilsonia pusilla pileolata*) and the white-crowned sparrow (*Zonotrichia leucophrys*) breed regularly in the thickets of alpine willows for 500 feet above timberline, but their breeding range also extends down through the Hudsonian zone. Other birds observed as stragglers above timberline are *Buteo borealis calurus*, *Chordeiles virginianus henryi*, *Corvus corax sinuatus*, *Junco phæonotus caniceps*, and a humming bird (probably *Selasphorus platycercus*).

PLANTS OF COLORADO ARCTIC-ALPINE ZONE.

The only shrubs able to withstand the rigorous climate on the wind-swept slopes of this region are several species of alpine willows, among which are *Salix petrophila*, *S. chlorophylla*, and *S. glaucops*, with its smooth variety *glabrata*. Dense thickets of these willows from a few inches to 3 feet in height occur from timberline to 13,000 feet, chiefly in ascending tongues through alpine bogs on the slopes of gulches and basins (see fig. 35); while *S. petrophila*, at least, is met with sparingly on the highest summits, at 14,000 feet. Some of the plants characteristic of the region above timberline are *Silene acaulis*, *Saxifraga debilis*, *Leptasea austromontana*, *Micranthes rhomboidea*, *Rhodiola polygama*, *Clementsia rhodantha*, *Mertensia alpina*, *Myosotis alpestris*, *Pedicularis grœnlandica*, *Polemonium confertum*, *Polygonum viviparum*, *Swertia palustris*, *Sieversia turbinata*, *Phlox condensata*, *Besseya alpina*, *Trifolium nanum*, *Thlaspi purpurascens*, and *Macronema discoideum*.[1] Most of the vegetation present above 13,000 feet consists of mosses and lichens.

MAMMALS OF COLORADO.

The following list is believed to include all species of mammals known to occur in Colorado, and aims to furnish accurate knowledge of their geographical and vertical distribution within the State. As already stated, it is based primarily upon investigations conducted in Colorado by the writer during the field seasons of 1905, 1906, 1907, and 1909. In addition, the data secured by other members of the Biological Survey during the past 20 years have been incorporated, and all important articles bearing on the subject, both old and recent, have been freely quoted.

The first accurate information regarding Colorado mammals was obtained on Maj. Long's expedition in 1820. Several species new to science were obtained within the State, and were described by Thomas Say in the Report of Long's Expedition to the Rocky Mountains, v. 2, 1823.

In the summer of 1871 Dr. J. A. Allen spent four weeks in Park County, securing data which later formed the basis of an important paper on the mammals of the South Park region, published in the Bulletin of the Essex Institute, VI, pp. 53–58, 1874.

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[1] As indicative of the arctic environment of this region, note the occurrence of *Pedicularis grœnlandica*, *Myosotis alpestris*, and *Polygonum viviparum*—species which are abundant in Greenland and Alaska.

Many Colorado mammals collected in the course of the United States Geographical Surveys West of the One Hundredth Meridian are recorded by Coues and Yarrow in v. 5 (Zoology) of the Report of the Survey, 1875. Other articles and notes of less scope pertaining to the subject, which have appeared from time to time in various publications, need not be detailed. Four important recent publications on Colorado mammals, however, often quoted in the present report, are here cited in full to avoid frequent repetition of the complete reference.

Allen, J. A. List of Mammals Collected by Mr. Charles P. Rowley in the San Juan Region of Colorado, New Mexico, and Utah, with Descriptions of New Species. <Bull. Am. Mus. Nat. Hist., V, pp. 69–84, 1893.

Warren, Edward R. The Mammals of Colorado. <Colorado College Publications, gen. ser. no. 19, Science ser. no. 46, XI, pp. 225–274, 1906.

Warren, Edward R. Further Notes on the Mammals of Colorado. <Colorado College Publications, gen. ser. 33, Engineering ser. 1, No. 4, pp. 59–90, 1908.

Warren, Edward R. The Mammals of Colorado. Pp. 300, with maps and numerous text figures. New York and London, 1910.

Didelphis virginiana Kerr. Virginia Opossum.

An apparently authentic instance of the occurrence of the opossum in Colorado was given me by Mr. George Heckler, a ranchman living in Shell Rock Canyon, in the northwest corner of Baca County. Mr. D. A. Rhinehart, of Lamar, who was familiar with the opossum farther east, afterwards verified Mr. Heckler's statement.

Mr. Heckler states that during the winter of 1903–4 he was hauling supplies from Las Animas to the sheep camps in southern Bent and Las Animas Counties, and one stormy evening camped in an old cabin among the cottonwoods near the head of Caddoa Creek, some 12 miles north of Gaume's ranch. Soon after kindling a fire in the fireplace, he saw a peculiar animal skulk in at the open door, and knocked it over with a stick of wood. After examining it and noting that it was an animal with which he was unacquainted, Mr. Heckler left it lying near the door, apparently dead. Happening to glance in its direction a little later, however, he saw the eyes slyly open for a look around, and the tales of "playing 'possum" which he had read came to his mind. Mr. Heckler kept the animal alive and gave it to a gentleman residing a few miles north of Springfield, where Mr. Rhinehart saw it soon after its capture.

The opossum is known to occur commonly in west-central Kansas, in western Oklahoma, and along certain of the streams on the Texas Panhandle. The individual captured on Caddoa Creek was probably a straggler, as careful inquiry in the Arkansas Valley and elsewhere in the region elicited no information respecting the presence of opossums. It may have reached the head of Caddoa Creek either by way of the

Arkansas, which is heavily fringed with cottonwoods from middle Kansas westward, or from the southeast, through the valley of the Cimarron River. Either route is a logical one for *Didelphis* to follow westward. Caddoa Creek is a southern affluent of the Arkansas River and has a scattering fringe of cottonwoods along most of its length. The region at the head of Caddoa Creek is wild and unsettled, and the cabin where the opossum was captured is the only one in many miles.

Cervus canadensis Erxleben. Elk; Wapiti.

The elk is now exterminated over much of its former range in Colorado, and the few bands which remain in the wildest parts of the western plateaus and mountains are small and widely scattered. The huge piles of antlers at many of the ranches in the northern mountains are a mute testimony to the former abundance of this noble animal. Estimates in 1898 placed the number of elk in Colorado at 7,000; in 1902 at 3,000. In 1909 their numbers were reduced to considerably less, and were divided about equally between northern and southern Colorado.[1] Conservative estimates of the number in Routt and Rio Blanco Counties varied from 200 or 300 to twice that number. Mr. Andrew R. Hodges, a well-known game warden with wide experience in the elk range, thinks there were fully 400 and possibly 500 elk in the mountains of Gunnison County up to 1909. In addition there are known to be small bands in the San Juan and La Plata Mountains and elsewhere.

In 1905, when I began work in Colorado, a few elk were still found in the Rabbit Ear Mountains, ranging on both their north and south slopes near the heads of Troublesome Creek (Middle Park) and Arapahoe Creek (North Park). A small band was said to range the Vasquez Mountains, and also on the headwaters of the Williams Fork of Grand River, while several other bands were reported on the White River Plateau, southeast of Meeker, probably at one time the best elk range in the State. In August, 1905, I found the nearly complete skeleton of a large bull elk in a narrow box canyon along the East Fork of Rifle Creek, 20 miles northeast of Rifle, and saw many mounted heads in Meeker, Newcastle, and Glenwood Springs. Mr. A. G. Wallahan, of Lay, reported that, unless they had been killed since 1904, a fair number of elk still remained in the Flat Top country at the eastern end of the Williams River Mountains.

In 1906 I learned of a few elk in the Danforth Hills (northwest of Meeker), in the mountains west of Green River, and along the crest of the Book Cliffs. A small band reported on the head of Elk River, on the western slope of the Park Range, is said to cross occasionally to the neighboring Elk Head Mountains. A mounted head at Baggs Crossing, Wyoming, belonged to a large bull elk which a trapper named Criss shot in the region between Sunny Peak and the Vermillion Bluffs in 1902. During the winter of 1905–6 two elk were seen at the Sand Springs, west of Sunny Peak, Routt County. Apparently none remain on the Medicine Bow and Front Ranges, or on the divide east of Laramie River, since I could get no definite information regarding their presence in that region in 1906. Dr. A. K. Fisher learned of a few on the south side of Longs Peak in 1894.

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[1] Careful estimates made by the Forest Service officers in the spring of 1911 show a total of about 2,100.

In 1907, 12 or 15 elk were reported in the Cochetopa Hills west of Saguache, and forest rangers estimated that there were nearly 100 remaining on the San Juan Mountains. These are much scattered, and are usually encountered singly or in twos or threes. One of the largest bands, consisting of about a dozen individuals, is said to range near the summit of the San Juans south of Wagon Wheel Gap. The same year fully 50 elk were reported in the La Plata Mountains, their favorite range being on the head of Hermosa Creek, northwest of Durango. Warren states that a few elk remain in Delta and Pitkin Counties.[1] They must have been at one time very abundant in the West Elk Mountains, as at Cebolla, in 1907, I saw large piles of antlers in front of the hotel.

Allen says that elk were becoming rare in Park County in 1871;[2] and Brewer, writing of South Park at the same period, records but three individuals observed by his party.[3] Trippe has recorded elk from the higher parts of Clear Creek County.[4]

Forest Supervisor H. N. Wheeler thinks the region on the head of Hermosa Creek, in the Montezuma National Forest, would be an ideal location for a national game preserve, with special reference to elk, since so many are living in that region. State and national pride should demand that this noble game animal, which formerly ranged the Colorado mountains by thousands, be given the protection which only a game preserve can afford. The close season on elk in Colorado extends to November 1, 1924 (amendment of 1909). It has hitherto been very difficult, however, to obtain in the wildest mountain districts a strict enforcement of the game laws.

Mr. Barrett Littlefield, of Slater, Routt County, had about 100 elk in captivity on his ranch on the northern slope of the Elk Head Mountains, a short distance south of that point, in 1906, and had raised calves and steer elk for a number of years, readily selling the dressed meat for 20 cents a pound at the nearest railroad point, Rawlins, Wyoming. The steer elk are said to weigh from 500 to 600 pounds when well grown. Gray wolves have killed a number of elk from Mr. Littlefield's herd during the past few years.

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[1] Mammals of Colorado, Colo. College Pub., Sci. ser. no. 46, XI, p. 236, 1906.

[2] Bull. Essex Inst., VI, p. 56, 1874.

[3] Am. Nat., V, p. 220, 1871.

[4] See Coues, Birds of the Northwest, p. 224, 1874.

Odocoileus virginianus macrourus (Rafinesque). White-tailed Deer.

The white-tailed deer is at present uncommon, being largely restricted to the foothills and eastern slopes of the front ranges, where it occurs sparingly across the entire width of the State. A very few have been killed on the mountain slopes bordering the San Luis Valley, but it appears to be absent from other sections west of the main ranges. In early days this deer was found pretty generally over the plains region of eastern Colorado, where it frequented the thickets and cottonwood growth which fringed the Platte, Cache la Poudre, Boulder, Arkansas, and other streams.

In 1905 Mr. Walter Blanchard informed me of a pair of white-tailed deer which had been on his ranch 5 miles west of Boulder for a number of years, and he has several times seen fawns. I saw deer tracks in the gulches in that vicinity several times during June, 1905. Near the summit of Floyd Hill, in the eastern edge of Clear Creek County, a fine large buck jumped from a dense thicket of dwarfed aspens directly in front of me, June 23, 1905. Settlers in that vicinity report small numbers of deer in the heavy forests several miles south of Clear Creek. A few white-tailed deer were reported in the yellow-pine belt west of Arkins, Larimer County, and in the Laramie River region. Mr. T. J. McKenna, of the Stevens mill, on Mount McClellan, states that this deer formerly occurred in the Grays Peak region, but that none have been seen recently. A specimen from the Cache la Poudre River was in the collection of mammals which Mrs. M. A. Maxwell exhibited at the International Exposition at Philadelphia in 1876.

White-tailed deer were reported at a number of localities in southern Colorado in 1907. A few are said to have been killed in the Wet Mountains east of Westcliffe during recent years. Mr. J. W. Frey, of Salida, considers the species of rare occurrence in that vicinity, but states that a few have heen seen recently in Pleasant Valley, on the east side of the Sangre de Cristo Range. This deer is reported rare at both La Veta and Bradford, in western Huerfano County, but several have been killed on the San Luis Valley slope of the Sangre de Cristo Range, in the vicinity of the Mosca and Medano Passes, within the past 10 years, according to the cowboys of the Medano Springs ranch. There is a skull in the National Museum from Rio Grande County, on the western side of the San Luis Valley.

Most of the hunters with whom I conversed had never seen the white-tailed deer in the juniper country of Las Animas and Baca Counties, but Mr. D. A. Rhinehart, of Lamar, stated that a very few were killed there in early times. The species was formerly common among the cottonwoods and willows along the Arkansas River, but apparently none remain. A ranchman living at Prowers Station, west of Lamar, is said to have a few in captivity, but I was unable to learn where they were secured. Warren gives the following data:

"C. E. Aiken says there are a few in the foothills west of Monument, El Paso County, unless recently killed off. Dr. W. H. Bergtold tells me it is still found near Trinidad and southward, and also in parts of the Arkansas Valley, between Pueblo and the State line."[1] Trippe says "*Cervus leucurus*" was formerly common in Clear Creek County.[2]

Odocoileus hemionus (Rafinesque). Mule Deer.

The mule deer has a much more general distribution in Colorado than *O. macrourus*, and ranges from the lowest foothills occasionally to timberline. It is found in every county west of the Continental Divide, being probably most abundant in Routt and Rio Blanco Counties. East of the main ranges a few are left in the rough juniper country of Las Animas and Baca Counties, in the higher parts of El Paso, Teller, and Jefferson Counties, and in 1907 they were reported tolerably common in the foothills of Custer and Huerfano Counties. Mr. Edward A. Preble reported a few mule deer in the Estes Park region in 1895, but I heard of none in the foothills of Boulder and Larimer Counties in 1906. Apparently none remain on the plains east of the mountains, where they were common in early times.

Abundant signs of deer were noted on all the mountains and plateaus west of the Front and Medicine Bow Ranges in August and September, 1905 and 1906. The aspen forests on the Rabbit Ear Mountains, White River Plateau, and in the Hahns Peak country were especially frequented by them, and large piles of antlers were seen at ranches throughout the region. The Flat Top country of the Williams River Mountains, west of Egeria Park, was said in 1906 to be the best deer country in the State. All the many hunting parties which I met returning from this region or the White River Plateau early in October of that year had been successful.

Mr. A. G. Wallahan, of Lay, Routt County, states that prior to 1900 large herds aggregating many hundreds of mule deer passed his ranch on the Lay game trail each fall in regular migration from their summer home in the Elk Head and Williams River Mountains to the winter range in the rough juniper and pinyon country bordering the lower Snake and Bear Rivers. Since 1900 their numbers have been greatly depleted, and during the winter of 1904–5 Mr. Wallahan saw only 17 in the vicinity of his ranch. These semiannual migrations performed by the mule deer from high to low country in the fall, and back again to the mountains in the spring, are now scarcely perceptible in most sections where 5 or 10 years ago they were important events.

In 1907 this deer was reported as tolerably common in the San Juan and La Plata Mountains, in Archuleta, La Plata, and Montezuma Counties. Formerly there was a regular movement down into the pinyon country on the Indian reservation along the southern border of the State, but during the past few years the Ute, Navajo, and Apache Indians have been ruthlessly slaughtering deer, and the greater number now remain throughout the year in the high country, where they are comparatively safe. Forest Ranger E. E. Chapson states that at present coyotes are the worst enemies of deer in the San Juan Mountains north of Pagosa Springs, as they kill a great many fawns in summer and numbers of adults in winter, when the snow crust impedes the deer's progress, but is strong enough to bear the weight of the coyotes. Mr. Chapson has often found the carcasses of deer thus killed, and states that the coyotes, usually hunting in bands of five or six, first hamstring the deer, after which they easily kill it. Mountain lions also kill a large number in the San Juan and La Plata Mountains.

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[1] Mammals of Colorado, p. 237, 1906.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

During the same season (1907) deer were reported common at various other points. On the Uncompahgre Plateau tracks were seen in abundance, both in the sandy yellow pine country at the head of Dominguez Creek and in the trails leading through the aspen groves along the crest of the plateau near Uncompahgre Butte. In the Coventry region a good many deer were inhabiting the pinyon country during July, and tracks were common also in the aspen country on Lone Cone. Before sunrise July 24 I saw a doe browsing in the willow brush in the bottom of the Naturita Canyon, near Coventry. Mule deer were quite common late in June in the oak and aspen thickets of the Lone Mesa region, where they were feeding extensively on acorns. During the winter they are said to range chiefly in the yellow pine country on the Dolores Plateau. Just before sunset June 26, as I was crossing a ridge on the southwest flank of Beaver Mountain, southeast of Lone Mesa, my eye was arrested by a beautiful sight. Standing in a small grassy opening among the dense oak chaparral a hundred feet below me and in the shade of the ridge, with head thrown back over his shoulders, nose pointing exactly in my direction, and every sense alert, stood a large, sleek-coated, 4-point buck. I stopped in plain sight and silently watched the old fellow for fully five minutes, and he apparently regarded me with equal interest. His curiosity was fully satisfied, however, the moment I quietly and slowly concealed myself among the oak brush, and lowering his head he loped off through the chaparral.

Deer were reported as more abundant than usual on the mountains bordering the San Luis and upper Arkansas Valleys, and nearly all the hunters outfitting at Buena Vista, Salida, and Saguache during the open season of 1907 met with success. A locomotive on the Denver & Rio Grande Railroad, running light, killed a fine buck November 8, in Browns Canyon, 6 or 8 miles north of Salida. On the western slopes of the Sangre de Cristo Range the mule deer is said to be usually found in the pinyon belt between 8,000 and 9,000 feet, although occasionally met with at timberline in summer and early fall. I was informed that deer were scarce in 1907 on the head of Smiths Fork, in the West Elk Mountains, and this was the case also in western Montezuma County.

Allen found mule deer, "*Cervus macrotis*," common near timberline in Park County in 1871;[1] while Trippe recorded the species as formerly common in Clear Creek County.[2]

The Colorado game law in force during 1907 and 1908 allowed the killing of one deer "with or without horns" by any person during the open season. This inclusion of deer without horns worked incalculable injury to the deer of Colorado during the two years it was operative, as a great many does and fawns were killed by unscrupulous hunters and particularly by novices. The pernicious results were not fully manifest in 1908, when it was estimated a total of about 2,500 deer were killed during the open season, but reports show that a great scarcity of deer throughout the mountains marked the season of 1909.

Antilocapra americana (Ord). Antelope.

Antelope are now comparatively scarce even in the thinly settled parts of the eastern plains region, and few remain on the sage plains of North Park and Routt County, where formerly there were thousands. A small number are still present in San Luis Valley. Most of the antelope of eastern Colorado are now in three areas—on the plains of western Baca and southern Otero, Bent, and Prowers Counties; on the Arkansas Divide; and in northwestern Logan and northeastern Weld Counties.

That this most graceful game mammal is doomed to early extinction in many sections seems probable despite the protection afforded by law, but the increase in numbers during the past few years, both on the Arkansas Divide and in northeastern Weld County, is very perceptible. The decrease of antelope in the State at large during the past 10 years, however, has been very great. In 1898 the State game warden placed the number at 25,000, while in 1908 the game commissioner estimated not over 2,000. A conservative estimate based on data collected by the Biological Survey would be not over 1,200 in 1909. Many cowboys and even ranchmen in the outlying districts kill antelope whenever they can. It is gratifying, however, to find that many large ranch owners have the public interests and the preservation of game sufficiently at heart to afford this fine mammal rigid protection on the ranges under their control.

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[1] Bull. Essex Inst., VI, p. 56, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

Mr. A. G. Wallahan, of Lay, the well-known photographer of big game, estimated in 1905 that 300 would fully cover the number of antelope remaining in Routt County. He reported a band of about 30 on the Iron Springs Divide, east of Godiva Ridge, and another larger band near Junction Mountain, between the Snake and Bear Rivers. In 1906 I was informed by Mr. John Criss, of Baggs Crossing, Wyoming, a trapper of many years' experience in Routt County, that only a few hundred antelope are left in that region; whereas as recently as 1898, immense herds, aggregating thousands of individuals, wintered there. During the summer the antelope were scattered over the sage plains in small bands. Mr. Criss thinks that persistent hunting in that region drove most of the antelope northward to the Wyoming plains. In 1906 antelope were reported in small numbers in North Park; on the sage flats bordering Muddy Creek, in northwestern Middle Park; on the divide between the Snake and Green Rivers, north of the Escalante Hills; and in the parks on the O-wi-yu-kuts Plateau. In August, 1906, I saw the tracks of small bands at the eastern end of Godiva Ridge (Routt County) and near Higho (North Park), while five or six were watering at Elk Springs, 8 miles south of Lily. I saw none in Mesa County, and Warren states, on the authority of Mr. W. P. Ela, of Grand Junction, that but two or three have been killed in that region during the past 20 years.[1]

Numerous data on the distribution of antelope in the San Luis Valley and in other parts of southern Colorado were gathered during the summer of 1907. None appear to remain in Montezuma County, and hunters in that region state that few were ever found there. Mr. George J. Ashbaugh, living in the McElmo Canyon, told me that the last antelope seen by him were three or four on the watershed between Yellow Jacket and McElmo Creeks about 1897. A conservative estimate of the number of antelope in the San Luis Valley would be from 50 to 75. The cowboys of the Medano Springs ranch, who range the eastern side of the valley from Crestone south to Garland, state that there are about 30 or 40 in that region, the largest band, consisting of about 25, being found on the Luis Maria Baca grant, south of Crestone. Others are scattered over the plains from the west base of Sierra Blanca north to the northern end of the sand dunes, west of the Medano Pass. Antelope are reported between Garland and San Luis, at the west base of the Culebra Range, and Vernon Bailey heard of a few in the unsettled region between Antonito and the Rio Grande in 1904. Mr. C. H. Auld, of Colorado Springs, reports seeing an antelope from the train between La Jara and Antonito September 18, 1907.

An antelope is said to have been killed, in the fall of 1907, within sight of Salida, presumably on the extensive flats in the Arkansas

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[1] Mammals of Colorado, p. 237, 1906.

Valley northwest of that point. This appears to be the only recent record in the upper Arkansas Valley. Antelope were not uncommon in South Park in 1871, according to Allen.[1] They were formerly abundant in the Wet Mountain Valley, but none have been seen in that region for several years.

Conservative estimates made by residents of Baca County in the fall of 1907 placed the number of antelope in that region at between 50 and 100. The majority were said to range on the level short-grass plains of western Baca County, just east of the rough juniper country. Very few are reported in eastern Baca County, which is well settled. Prof. D. E. Lantz reports possibly 12 antelope on the plains north of Higbee, in southeastern Otero County, in 1910.

Antelope were reported by Mr. C. P. Streator as common on the high plains of the Arkansas Divide near Flagler and Limon in 1894, and Prof. Lantz says their numbers were increasing near Hugo in 1905, owing to rigid protection. In May, 1909, I saw a band of fully 20 from a Rock Island train about 10 miles east of Limon, and in crossing the Arkansas watershed from Cheyenne Wells northwest to Seibert I saw several small bands. One band of nearly 200 is said to have been seen near Agate, on the northern slope of the Arkansas Divide, northwest of Limon, in December, 1908. Several antelope were run over by trains in that vicinity the same winter, which was one of excessive snowfall. This was due to the fact that, in feeding along the railroad right of way, which was kept fairly clear of snow, the antelope became quite unsuspicious and accustomed to passing trains.

In driving from Sterling northwest to Grover early in June, 1909, several small bands of antelope were encountered on the flats bordering Horsetail Creek south of the Chimney Cliffs, while on the undulating grassy plateau northwest of Pawnee Buttes, where the antelope seemed most numerous, 19 were counted in the course of a short morning's drive. From observations made during the winter of 1908–9 residents variously estimate at from 200 to 300 the antelope in the region between the Burlington Railroad from Cheyenne to Sterling and the Nebraska boundary. A point 10 miles west of the Platte River at Iliff indicates the present eastern limit of range in winter, while the summer range is still more restricted.

A very few antelope are found in Yuma County, according to Mr. W. E. Wolfe, of Wray. Mr. H. G. Smith, of Denver, states that they were last seen in Denver County in the late seventies.

Bison bison (Linn.). Buffalo; American Bison.

The buffalo was formerly present over much of the State, even ranging in summer to timberline in certain sections of the mountains, as is proved by the bleached and weathered skulls occasionally found at that elevation. While most numerous on the plains east of the mountains, they nevertheless must have been common in the larger mountain parks, especially on the sage plains of North Park, where the bleached skulls, now rapidly disintegrating after more than 20 years' exposure, may still be seen in considerable numbers. A favorite range of the buffalo was the extensive region of sage plains in western Routt County, where in sections least frequented by range cattle the deeply worn trails can still be distinguished. Few, if any, well-preserved skulls can be found at the present time. On my trips in North Park and in Routt County in 1905 and 1906 I met with only one skull at all complete, and in this case the teeth were lacking. This skull was found embedded in a bog north of Higho, North Park, and had been little exposed to the weather. In most of the skulls found the nasals and horn sheaths, as well as the teeth, are missing.

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[1] Bull. Essex Inst., VI, p. 56, 1874.

The South Park plains were much frequented by buffalo in early times, and nearly all the travelers passing through the region mentioned them. They were by no means confined to the open grassy plains of the park, since Brewer records skulls found on the bordering mountain slopes as high as 11,000 feet in both openings and forests.[1] The same writer states that the mountain animals were unlike the buffalo of the eastern plains, being smaller, with longer, shaggier, and blacker hair.[2] Allen mentions bleached skulls found far above timberline on Mount Lincoln, by Mr. Bennett and others on the "extremest sources" of the Platte River.[3] Warren records a skull which he found in the mountains near Irwin, Gunnison County, at nearly 11,000 feet, and states that he has seen skulls at other localities in the West Elk Mountains.[4]

The data at hand respecting the time of the buffalo's disappearance in most sections of the mountains are scanty. According to Brewer (l. c.) it was abundant in South Park previous to 1862, and a few were shot in 1867, while he "heard of none in 1869." Allen (l. c.) states that a small band was seen along the Platte River in South Park in June, 1871, while Coues and Yarrow, writing of the South Park region, state that a few were seen and two were killed in 1873.[5] Mounted specimens in the Maxwell collection of Colorado mammals exhibited at the Philadelphia Exposition in 1876 were shot in September, 1873, near Mount Whiteley, Middle Park, according to Coues, who also states that a small band of buffalo still lingered in North Park in 1876.[6] The last buffalo in the Pikes Peak region seems to have been a bull, killed in 1879 near the Seven Lakes, and mounted by Mr. C. E. Aiken, of Colorado Springs, as recorded by Warren (l. c.). The famous and somewhat mythical "Lost Park Herd" appears on good authority to have lived in the fastness of its mountain retreat in comparative safety for many years after its fellows in other sections of the mountains had been exterminated. The remnant of this herd—two bulls, one cow, and one calf—were all killed in February, 1897, in Lost Park, near Bison Peak, Park County.[1] The last buffalo in Routt County appears to have been one killed by Ute Indians at Cedar Springs, 6 miles west of Craig, in 1884.[2]

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[1] Am. Nat., V, p. 221, 1871.

[2] In this connection, see Allen, Bull. Essex Inst., VI, p. 55, 1874.

[3] Bull. Essex Inst., VI, p. 55, 1874.

[4] Mammals of Colorado, p. 239, 1906.

[5] Explorations W. of 100th Meridian, V, p. 67, 1875.

[6] Dartt, On the Plains and among the Peaks, p. 221, 1879.

The buffalo of the plains east of the mountains appear to have made their last stand in Baca County, in the extreme southeast, where one was killed near Springfield as late as 1889. This is the same year that the remnant of the Texas herd, driven to the northwest corner of the Panhandle, was estimated by Dr. W. T. Hornaday at 25.[3] As the Baca County plains are practically a northern continuation of the Llano Estacado, and but a short distance north of the Panhandle, it seems altogether likely that the buffalo killed in Baca County, a cow heavy with calf, had strayed from the Texas herd, as the animals remaining on the eastern Colorado plains had been exterminated several years before.

Ovis canadensis Shaw. Mountain Sheep; Bighorn.

A few bands of mountain sheep live on nearly all the high mountain ranges of Colorado. On the main ranges they are usually seen at or near timberline and seldom below the Canadian zone. On the plateaus and in the rough country of western and southwestern Colorado, however, they occur at much lower elevations.

Mountain sheep show a gratifying increase during the past few years over the State at large. Although they have been protected by law in Colorado since 1885, the marked increase at the present time is the result both of a more efficient game-warden service and of local protection afforded by an aroused public sentiment. A danger which threatens mountain sheep in Colorado, as well as in other Western States, is the introduction of scab from domestic sheep allowed to graze on the higher mountain slopes. An instance is given by Warren, as follows:

> C. F. Frey tells me they suffer much from scab in the West Elk Mountains, and that a party told him in 1902, at one place near the head of Sapinero Creek, 75 head were counted which had died of scab. Domestic sheep have been run in that locality, and the wild sheep doubtless contracted it from them.[4]

In the northern ranges mountain sheep were tolerably common in 1905 and 1906. Lumbermen at Fraser, Middle Park, reported two bands, each numbering about 20, in the neighboring mountains. One of these bands is found on the Front Range, west of Berthoud Pass, and thence north on the Vasquez Mountains to Vasquez Peak; the other is usually seen near Arapahoe Peak, but ranges along the crest of the Front Range from James Peak as far north as Longs Peak. The sheep reported in the vicinity of Silver Plume and Graymont doubtless belong to one of these bands. Another large band was said to be found on the Medicine Bow Range between Lulu Pass and Clarks Peak. At Spicer, North Park, I saw the heads and capes of two fine rams which had been killed near Clarks Peak in the spring of 1905. These heads measured between the horn tips 15 and 15½ inches, respectively. This band is stated to range near timberline even in winter. A few sheep are still found in the mountains near Estes Park, but they are more common on the western slope of the range. A band of about 30 was seen by Nelson in the summer of 1883 on the summit of the range west of Estes Park. They were reported in 1905 as tolerably common on the Park Range between Buffalo Pass and Mount Zirkel. Other small bands were reported in the Elk Head Mountains and near Pyramid Peak in the Williams River Mountains. Mr. John Criss, of Baggs Crossing, Wyoming, states that one or two sheep have been killed in the rough country north of Snake River, in the vicinity of Sunny Peak, since 1900. A very few were also reported on Junction Mountain (between Snake and Bear Rivers), and on Zenobia Peak and Mount Cullom, near the Ladore Canyon of Green River. In 1902 Dall De Weese estimated their number as probably 700 in the State. A large ram was killed among the Snake River bluffs north of Lily during the winter of 1905–6.

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[1] See American Field, p. 273, Mar. 19, 1910.

[2] Felger, Univ. of Colo. Studies, VII, No. 2, p. 143, 1910.

[3] Extermination of the American Bison, Rept. U. S. Nat. Mus., 1889.

[4] Mammals of Colorado, p. 238, 1906.

On October 16, 1906, while far above timberline in the mountains south of James Peak, and on the edge of a small lake in a deep basin surrounded by rather precipitous walls, the crashing of a number of loosened rocks on the slope opposite broke the deep silence. No sheep were visible on the rocky ledges far above, but upon climbing the steep slope I discovered the fresh tracks of a large ram and a ewe in the snow on the crest of the divide at 13,000 feet.

In 1907 sheep were reported on most of the mountain ranges of southern Colorado, and seemed to be on the increase. The sharp, jagged peaks and ridges of the high and narrow Sangre de Cristo Range afford a fine home for them, and they are said to be found along its entire length, being in greatest numbers in the Sierra Blanca group at the southern end. Cowboys riding for the Medano Springs ranch often meet with sheep among the pinyons along the lower western slopes of the Sangre de Cristos between Mosca Pass and the southwest flank of Sierra Blanca. A very few are reported also on West Spanish Peak, south of La Veta, and on Pikes Peak. Forest

Ranger E. E. Chapson, of Pagosa Springs, says that a good many sheep are killed by snowslides in the San Juan Mountains north of that point. In one instance he discovered the carcasses of three or four sheep which apparently had been so closely shut in by a snowslide as to be at the mercy of a band of coyotes. The snow crust was sufficiently strong to bear the light-footed coyotes, but too weak to support the heavy-bodied sheep, and unmistakable signs in the snow showed that the sheep had been killed and partly eaten. Mr. J. P. Galloway, of Norwood, states that sheep are often seen on Dolores Mountain, but seldom range west across the valley to Lone Cone, the westernmost peak of the San Miguel Mountains. Some years ago a band of about 20 crossed to the Cone, but soon returned to the more extensive range on Dolores and neighboring mountains.

Mountain sheep are not at all uncommon in the rough Upper Sonoran country of extreme western Montrose and Mesa Counties. Most of the region on both sides of the Dolores River below Paradox Valley is very precipitous and quite inaccessible, affording an excellent sheep range. Most of the sheep in this region live on the east side of the Dolores, between Salt Canyon and the mouth of West Creek, chiefly on the very broken southwest face of the Uncompahgre Plateau. A very few are reported among the rocky ridges just below the steep northern rim of West Paradox Valley, and Mr. William Boren, of Norwood, informed me of a lone ram which has been seen several times on the rocky points along the east side of the Dolores Canyon, just south of Paradox Valley. Sheep are said to be tolerably common in the West Elk Mountains, and occasionally range down to the cliffs along the Gunnison, southwest of Crawford, during the winter.

Brewer found sheep common on the mountains surrounding South Park in 1871, and states that they were particularly abundant above timberline on the highest peaks.[1]

[**Sciurus niger rufiventer** Geoffroy. Western Fox Squirrel.

Fox squirrels are not indigenous to Colorado, but have been introduced at Greeley, where they are increasing in a gratifying manner, and also, according to Young, at Denver.[2]]

Sciurus aberti ferreus True. Northern Tuft-eared Squirrel.

Sciurus aberti concolor True, Proc. U. S. Nat. Mus., XVII, p. 241, 1894. Type from foothills west of Loveland, Larimer County, Colorado. (Not of Blyth.)

Sciurus aberti ferreus True, Proc. Biol. Soc. Wash., XIII, p. 183, 1900.

This interesting form of *Sciurus aberti* has a much interrupted range in the yellow pine belt of the eastern foothills, between 6,000 and 8,000 feet in northern Colorado, and chiefly between 7,000 and 9,500 feet farther south. Judging from the meager data at hand its range was formerly continuous or nearly so, but now it is largely restricted to the higher foothills west of Loveland, eastern Park and southern Jefferson Counties, the Arkansas Divide between Monument and Eastonville, and the eastern slopes of the Sangre de Cristo Range between the Medano and Mosca Passes. (See fig. 2.)

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[1] Am. Nat., V, pp. 220–221, 1871.

[2] Proc. Acad. Nat. Sci. Phila., p. 406, 1908.

Although the species is commonly reported by hunters and ranchmen in the foothills of southern Larimer County, my experience in the pine belt west of Arkins (practically the type locality) in July, 1906, leads me to believe that it is now uncommon, if not rare, in that section. Several days were spent among the heavy forests of yellow pines between 6,000 and 7,500 feet in a systematic search for these squirrels, but not a single one was seen or heard. One informant stated that the squirrels come down into the valleys in the autumn and feed extensively upon the wild plums. In October, 1894, Mr. C. P. Streator collected two squirrels 12 miles west of Loveland, but found the animals scarce. He attributed this scarcity to a shortage in the crop of pine cones, upon which the squirrels are said to feed. In the fall and winter months of 1894, 1895, and 1896 Mr. R. S. Weldon collected 12 specimens 3 miles northwest of Arkins and 1 at Bellevue. Possibly this squirrel lives at a higher elevation in summer than in winter, but there are no data on this point. The type

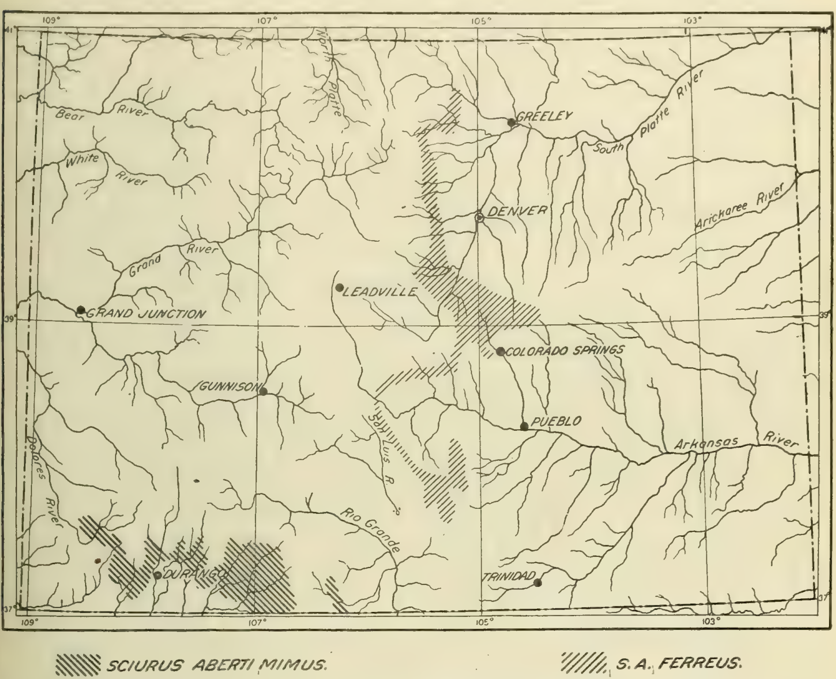
109°
107°
105°
103°
41°
39°
37°
North Platte
Bear River
White River
Grand River
GREELEY
South Platte River
DENVER
Arickaree River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD
▧ SCIURUS ABERTI MIMUS.
▨ S. A. FERREUS.

FIG. 2.—Distribution in Colorado of tuft-eared squirrels (*Sciurus aberti mimus* and *S. a. ferreus*).

and one topotype in the National Museum were collected west of Loveland by Mr. W. G. Smith.

In 1905 Mr. Edward Allensby, living in the South Boulder Canyon, 14 miles southwest of Boulder, reported a few of these squirrels in the pine forests of that vicinity, stating that they were usually observed during the winter months. Mr. Walter Blanchard, of Boulder, saw a melanistic specimen which was killed near Sugar Loaf Mountain, 10 miles west of Boulder, about 1903. Mr. T. J. McKenna, of Denver, states that many years ago, while located at Jamestown, Boulder County, a few black squirrels were found in that vicinity. In 1894 Streator learned of five squirrels which had been killed in the vicinity of Gold Hill.

This squirrel was reported at a number of localities in southern Colorado in 1907, where it seems to be more common than farther north. It was said to be not at all uncommon in the pine forests of eastern Park County between 8,000 and 8,500 feet, especially on Craigs Creek and along the North Fork of the Platte near Bailey. Prof. D. E. Lantz found it common among the pines at Cascade in July, 1910. Mr. J. W. Frey reports a very few in the Arkansas Hills east of Salida, and Mr. C. E. Aiken, of Colorado Springs, has a summer skin from the Cripple Creek region, which is gray with a trace of reddish in the middle of dorsum, thus greatly resembling *S. a. mimus* in faded pelage. *Sciurus ferreus* has been seen on the San Luis Valley side of the Sangre de Cristo Range, according to cowboys of the Medano Springs ranch, Mr. William King having seen a few gray individuals among the pines at the west end of Mosca Pass, and others reporting it from Medano Pass. The species is quite generally distributed along the eastern slopes of the Sangre de Cristos north at least to Westcliffe, and it is said to occur also in the Wet Mountains. In the region around Bradford, in the northwestern corner of Huerfano County, this squirrel is said to be tolerably common, both on the slopes east of Medano Pass and in the pine-clad gulches of Promontory Bluffs, the vertical range here being from 8,000 to 9,500 feet. The inclement weather prevailing in this region during mid-November doubtless accounted for the inactivity of squirrels, as none were seen, but signs of their presence were found in large nests of pine needles in the upper branches of pines and also in fresh cuttings scattered here and there over the forest floor.

The species reaches its greatest abundance in the yellow pine forest on the Arkansas Divide between Eastonville and Monument. In the forest southwest of Eastonville the squirrels were active during the bright crisp days of early December. The forest floor for a considerable radius around the nest trees was generously sprinkled with fresh green cuttings of branch tips, pieces of gnawed bark, and freshly peeled twigs, while a few of the upper limbs of the trees were gnawed and peeled in places, much as if by porcupines. The squirrels themselves were very quiet and shy and were seldom observed, and not a single sound was heard which could be attributed to them. I hunted carefully for the larger part of a day before catching sight of one, and then secured two fine brown males, two black males, and one black female. These specimens are in beautiful long and silky winter pelage, and the ear tufts are of maximum length. The fur of melanistic specimens is of fine quality, and were the squirrels numerous it would undoubtedly be in great demand.

The nests are nearly always constructed of pine needles and lined with strips of the inner bark of the pine. In the Eastonville region I found *S. ferreus* living entirely in open nests, but near Bradford it is said often to take up its abode in hollow pines and even in hollow cottonwoods (*Populus angustifolia*).

This squirrel is one of the most striking examples of extreme melanism among mammals. Of the 24 specimens in the Biological Survey and National Museum collections, including the type, 19 are melanistic (either black or dark brown) and 5 are gray. A man who had hunted in the Estes Park region for a great many years informed Streator in 1894 that out of nearly 100 of these squirrels which he had seen or killed only 1 was gray. This ratio is, of course, much too high, but it is certain that melanistic individuals preponderate in most sections. Near Eastonville I saw no squirrels in the gray phase, nor could I learn of any having been seen there. Mr. C. E. Aiken states, however, that in a batch of nearly 150 skins of *S. ferreus* which he purchased many years ago from the region between Monument and Eastonville, the black phase was most common and the brown phase next, while there were a very few gray skins. An odd skull, which I secured at Bailey, belonged to a black squirrel. On the slopes of the Sangre de Cristo Range the gray phase seems to be more common than elsewhere, and no black squirrels were reported from the Mosca and Medano Passes.

Sciurus aberti mimus Merriam. Tuft-eared Squirrel.

So far as known, this large, handsome squirrel occurs in Colorado only in the extensive yellow pine forests which clothe the lower slopes of the San Juan and La Plata Mountains, in Conejos, Archuleta, La Plata, Montezuma, and Dolores Counties, in the Transition zone. (See fig. 2.) The center of abundance appears to be the Pagosa Springs region, Archuleta County, between 7,000 and 7,500 feet.

Tuft-eared squirrels are commonly reported from the upper valley of the Los Piños and along Vallecito Creek, in northeastern La Plata County, and are found sparingly to the lower edge of the pine belt a few miles north of Bayfield, but are said never to range down into the pinyon country. The species has been recorded from Florida, La Plata County, by Allen.[1] One was noted at 8,200 feet in the upper edge of the yellow pine belt on the southwest slope of Pagosa Peak. Mr. Steve Elkins, of Mancos, states that a few of these squirrels inhabit the pine forests at the western base of the La Plata Mountains, and their range extends a short distance out on the Dolores Plateau, northeast of Dolores. In crossing this plateau between Dolores and the Lone Mesa late in June, 1907, I saw no signs of squirrels, but learned from Forest Ranger James Lowell that they are present in small numbers. The Dolores Plateau appears to mark the northern limit of the range, as none were found in the yellow pine forests which clothe much of the San Miguel Plateau, the northern slopes of the San Miguel Mountains, and the Uncompahgre Plateau. Vernon Bailey says this squirrel was reported to him as common in the eastern foothills of the San Juan Mountains, 10 miles west of Antonito, Conejos County, in August, 1904. This is the only record of its occurrence in Colorado east of the Continental Divide. On the east side of the San Luis Valley, and along the eastern slopes of the front ranges, this form is replaced by *S. a. ferreus.*

This squirrel is characteristic of the stately yellow pine forests near Pagosa Springs and in the open vistas can be seen at a considerable distance. It is often first detected on the ground, moving about among the pine cones which carpet the forest floor in many places. When alarmed, it lopes leisurely up to the base of a pine, usually the nest tree, which it seems reluctant to climb, barking and scolding at the intruder until approached somewhat closely. When thoroughly frightened, it betakes itself to the higher branches, and its claws make a very audible sound on the dry bark. When seated motionless on an exposed limb far up in a big pine, this squirrel presents an odd appearance, due to its long hairy ear tufts. Once safely within the confines of the nest tree it will occasionally scamper part way down the trunk in a daring fashion, chattering excitedly. In climbing up or down a tree it spreads its feet far apart and by its flat appearance reminds one strongly of a flying squirrel.

The nest tree—usually a large dead pine with a hollow sufficiently large for the squirrels' home—is generally located in the heaviest forest, and very few of the animals live in small timber or along the outskirts of the forest. A few nests, composed largely of dry pine needles, were seen in the upper branches of large pines, but most of the squirrels appeared to be living in hollow trees. A stomach examined at Pagosa Springs contained a mass of finely masticated green material which could not be identified with certainty, but probably consisted of the inner bark of the terminal branches of the yellow pine. One squirrel was seen gnawing the bark from a good-sized limb, apparently feeding. The many freshly cut tips of terminal branches beneath the pines in the neighborhood of the nest trees attest to the squirrels' activities.

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[1] Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

In the silence of the vast forest reaches, the calls of this squirrel are at times the only sounds which reach the ear. During rainy or inclement weather, however, the squirrels are inactive and the calls rarely heard. The soft bark, sometimes sounding like wuh, wuh, wuh, and again like chuck, chuck, chuck, is usually repeated three or four times at short intervals, and each call is accompanied by a jerk of the tail. These squirrels are occasionally kept in confinement and are said to make desirable pets.

In a series of four males and two females collected a few miles west of Pagosa Springs, May 29, 1907, two were only about two-thirds grown. Fully half the squirrels noted here during the last week in May were immature, easily distinguishable on a tree by a dark-colored area in the middle of the dorsum. In adults this area is generally reddish.

Sciurus fremonti Aud. and Bach. Fremont Squirrel; Chickaree.

> *Sciurus fremonti* Audubon and Bachman, Quad. N. Am., III, p. 237, 1853. Type from "Rocky Mountains" (probably from the Park region of central Colorado).[1]

The Fremont squirrel lives in the coniferous forests throughout the mountains of Colorado, and ranges from the upper edge of the yellow pine belt to timberline. (See fig. 3.) It is typical in the Canadian zone of the main ranges, but on the western plateaus becomes slightly reddish on the rump and upper surface of the tail, as shown by a large series of specimens from various localities. This squirrel is usually common wherever found, and its lively, cheering chatter is one of the few sounds which break the silence of the high mountain forests. On the main ranges it occurs chiefly in the forests of lodgepole pine and Engelmann spruce, but in the southern mountains is perhaps more common in the forests of white fir (*Abies concolor*), while on the western plateaus it frequents the more open growth of Douglas spruce on the summits and upper northern slopes. In the Escalante Hills this squirrel is reported to come down among the yellow pines, at 7,000 feet, during the winter, and in a great many sections I have found it along the extreme upper edge of the Transition zone, at 8,500 feet, where pockets of balsam and aspen are scattered among the yellow pines. I shot one individual in the Upper Sonoran zone, at 6,000 feet, on Tabeguache Creek, 8 miles north of Nucla, Montrose County. It was in almost the last yellow pine found along the creek, at a point where the canyon sides were clothed with junipers and pinyons, but really within a short distance of the Canadian zone forests.

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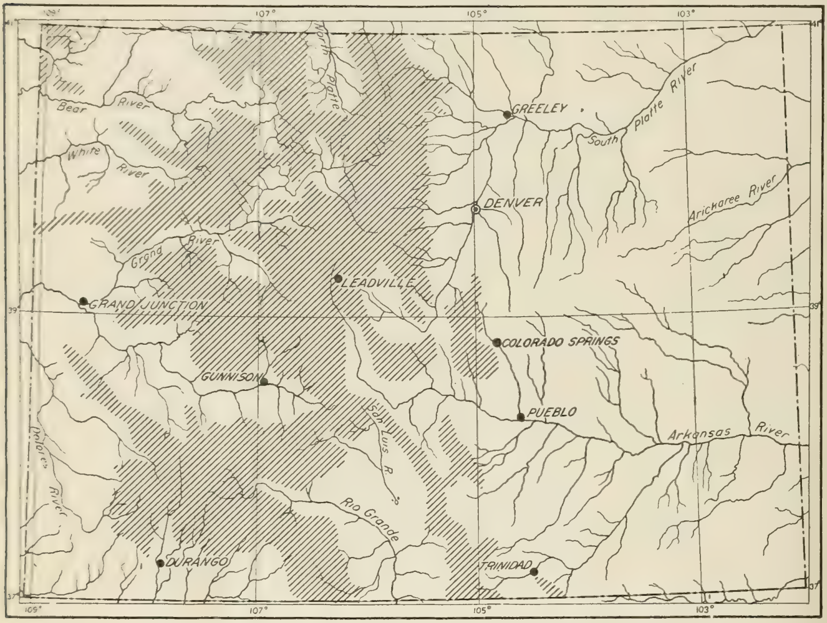
[1] So considered by Dr. J. A. Allen, who treats the matter in detail in Bull. Am. Mus. Nat. Hist., X, pp. 289–290, 1898. Dr. Allen's conclusion that the type specimen of *fremonti* (in the collection of the Philadelphia Academy of Natural Sciences) was not collected near South Pass, Wyo., as had been previously supposed, is confirmed by specimens in the Biological Survey collection. Large series of squirrels from the Wind River Mountains, near South Pass, and also from the Green, Ferris, and Laramie Mountains to the east and south, are quite distinct from *fremonti*, being referable to the northern *S. hudsonicus* group.

Like the common northern red squirrel, which it greatly resembles in all respects except color, *S. fremonti* feeds chiefly upon pine and spruce cones, which are hoarded in large caches at the bases of trees, beneath logs, and among rocks. I have never found it living in a hollow tree, although it may do so occasionally. The nests of pine or spruce needles and fine strips of bark are usually constructed in the fork of a branch well out from the main trunk, at from 20 to 40 feet above the ground, and in the densest forest. I have found the nests occupied by the squirrels in both summer and winter. This squirrel is not at all shy, and may be coaxed to within a few feet by making a nondescript "screeping" noise. One seen by Mr. Morris M. Green, near Almont, in August, 1909, was laboriously ascending a tree, carrying a large cantaloupe rind, which had been left by a camper. In some localities it is called the little gray squirrel, which is, of course, a misnomer, as it is subgenerically different from the gray squirrels and its color is olive brown.


109°
107°
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103°
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Bear River
White River
North Platte
GREELEY
South Platte River
DENVER
Arickaree River
Grand River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
San Luis R.
PUEBLO
Arkansas River
Dolores River
Rio Grande
DURANGO
TRINIDAD

FIG. 3.—Distribution in Colorado of Fremont squirrel (*Sciurus fremonti*).

(?) **Sciurus fremonti neomexicanus** Allen. New Mexico Chickaree.

It is not certain that *neomexicanus* occurs within the State, but it has been taken at Costilla Pass and Bear Canyon, New Mexico, both localities within a few miles of the Colorado boundary. A. H.

Howell thinks that a squirrel which he saw among the pinyons near Trinidad in September, 1903, was this reddish form of *S. fremonti*; while others seen by Mr. J. H. Gaut on the Conejos River, 12 miles west of Antonito, may have been *neomexicanus*. Unfortunately, there are no specimens from along the southern edge of the State, and the identity of the squirrels found in the southern San Juan and Culebra Mountains can be decided only by future investigations.

Eutamias quadrivittatus (Say). Say Chipmunk.

Sciurus quadrivittatus Say, in Long's Exped. Rocky Mts., II, p. 45, 1823. Type from Arkansas River, about 26 miles below Canon City, Colorado.

This large chipmunk, the four-lined squirrel of Say, was described from a specimen taken by Maj. Long's party at a point on the Arkansas River about 30 miles below the place where the river leaves the mountains, July 17 or 18, 1820. This point, as Dr. Merriam has already shown,[1] was probably about 26 miles below Canon City. The species has its center of abundance in the yellow pine belt of the Transition zone in the eastern foothill region, where it ranges nearly across the State from north to south. In Larimer County its known range is restricted to the lower eastern slopes of the Medicine Bow Mountains south of Arkins. Farther south, *E. quadrivittatus* has a wide distribution within its zonal limits, and is occasionally taken in the Canadian and Upper Sonoran zones. In the southern tier of counties it extends east to the western edge of Baca County[2] and west to La Plata County. The western limits may be roughly indicated by Florida and Bayfield, La Plata County; Silverton; Sapinero; St. Elmo, Saguache Mountains; near McCoy, Eagle County; Grand Lake; and Medicine Bow Range. (See fig. 4.) A large series of specimens from Canon City (near the type locality) and from a great many localities over the range of this species are in the Biological Survey collection.

West of the Front and Saguache Ranges I have taken this species at only one locality, Sapinero, in the valley of the Gunnison, at 7,300 feet, but it has been collected at Sulphur Springs, Grand Lake, near Sheephorn Pass, and near McCoy, as recorded by Warren.[3] In extreme southern Colorado *quadrivittatus* is found in the foothills bordering the San Luis Valley and is common west of the Continental Divide, being especially numerous in the yellow pine forests of Archuleta and La Plata Counties, on the southern slope of the San Juans. In this region it is not uncommon in the pinyon belt, as at Arboles and south of Bayfield, and was not seen above 7,500 or 8,000 feet north of Pagosa Springs or in the Vallecito region. This chipmunk has, however, been taken at Silverton (9,000 feet). West of the La Plata Mountains, and apparently west of their southern extension, it is replaced by the Hopi chipmunk (*E. hopiensis*). The limits of these two species along the San Juan River have not been ascertained, but it is quite possible the ranges meet, as at McCoy, on the upper Grand River.

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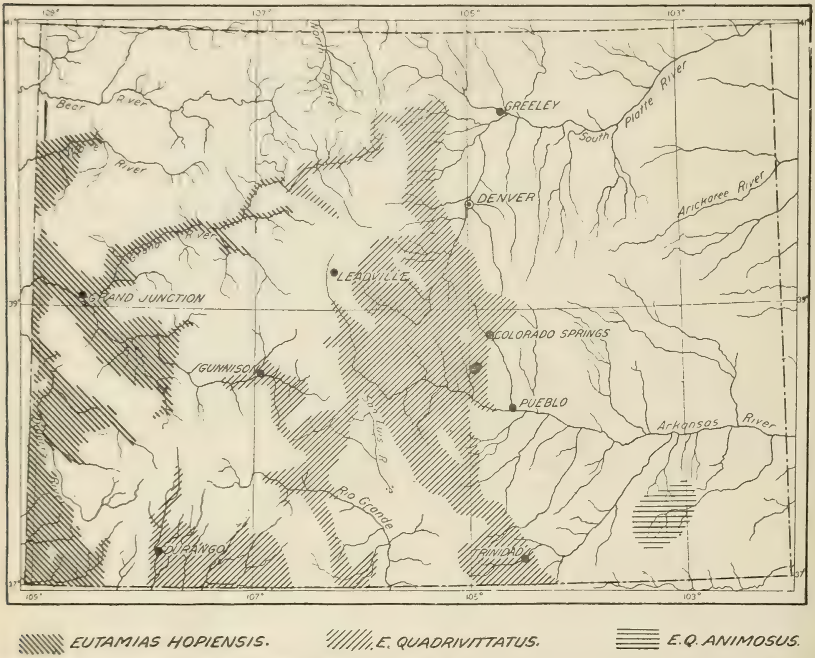
[1] Proc. Biol. Soc. Wash., XVIII, p. 163, 1905.

[2] The Baca County chipmunks have been recently separated as a pale race by E. R. Warren (Proc. Biol. Soc. Wash., XXII, p. 105, 1909).

[3] Further Notes on the Mammals of Colorado, Colo. College Pub., gen. ser. no. 33, p. 68, 1908.

At Sapinero, in mid-October, 1907, *E. m. consobrinus* was the only chipmunk seen alive, but October 15 three specimens of *quadrivittatus* got into my mousetraps along the rocky ledges of a gulch extending from the Gunnison River up through the sagebrush slopes southwest of the town. The species doubtless reaches the Gunnison region from San Luis Valley by way of Cochetopa Pass, rather than across the high Saguache Range, since at St. Elmo, on the east side of this range, it was not observed in the Hudsonian and Arctic-Alpine zones, although tolerably common in the Chalk Creek Valley, at 10,000 feet. In the Upper Arkansas Valley it is abundant to a short distance above Buena Vista. At Como, in South Park, several were seen on the timbered ridges at 10,000 feet, one being noted in the upper branches of a foxtail pine (*Pinus aristata*).


109°
107°
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North Platte
Bear River
River
Grand River
GREELEY
South Platte River
DENVER
Arickaree River
LEADVILLE
GRAND JUNCTION
39°
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
DURANGO
TRINIDAD
37°
105°
107°
105°
103°
EUTAMIAS HOPIENSIS.
E. QUADRIVITTATUS.
E.Q. ANIMOSUS.

FIG. 4.—Distribution in Colorado of Hopi, Say, and Las Animas chipmunks (*Eutamias hopiensis, E. quadrivittatus,* and *E. q. animosus*).

E. quadrivittatus is the largest and best known of the Colorado chipmunks, and is the one commonly seen along the eastern base of the foothills. At several localities, notably at Colorado Springs and

Boulder, the ranges of this species and the smaller *operarius* of the boreal zones overlap for a vertical distance of nearly 3,000 feet. The two chipmunks are easily confused in life, as the coloration is very similar, but *quadrivittatus* is considerably larger and slightly brighter in color. Like most chipmunks, this species is out in greatest abundance during the early morning hours or late in the afternoon, and may be seen frisking about the rocks and stumps of trees on the sides of canyons or along fences or busily feeding in the thickets of wild cherry and June berry so abundant in the canyon bottoms. It is usually shy, and when surprised hastily takes refuge among the rocks, uttering high-pitched, chippering notes. The ordinary note, however, is a soft chuck, chuck, usually uttered when the animal is at a distance from the observer and either sitting on the summit of a large rock far up the canyon side or on a tree stump in the silence of the yellow pine forest.

The food consists chiefly of seeds of various weeds and grasses and of *Cercocarpus parvifolius*, the fruit of the prickly pear (*Opuntia*), and also juniper berries, currants, wild cherries, and June berries. In autumn this chipmunk gathers a winter's supply of food, hoards it in crevices and under rocks, and goes into at least partial hibernation over most of its range, according to the length and severity of the winter. It is often out in mild winter weather.

Eutamias quadrivittatus animosus Warren. Las Animas Chipmunk.

Eutamias quadrivittatus animosus Warren, Proc. Biol. Soc. Wash., XXII, pp. 105–106, June 25, 1909. Type from Irwin's ranch, Las Animas County, Colorado.

The range of this large pale race of *E. quadrivittatus* is imperfectly known. Warren based his description upon three specimens, all taken by himself in the rough Upper Sonoran juniper country of northwestern Baca and northeastern Las Animas Counties, at elevations of about 5,000 feet. The first specimen he secured in the spring of 1905, at Gaume's ranch, Shell Rock Canyon, in the northwest corner of Baca County. No more specimens were known until April, 1909, when Warren made another trip to the region and collected two more at Irwin's ranch, in Las Animas County, some 12 miles west of Gaume's ranch. (See fig. 4.)

In late November, 1907, I made a trip to Gaume's ranch, but failed to see any chipmunks, as they were already in hibernation. They were reported to be common, however, in the juniper country of that section. Although the two localities at which specimens have been taken are close together, it seems probable that this pale chipmunk will be found to occupy most, if not all, of the rough juniper and pinyon country of Las Animas and western Baca Counties, locally known as The Cedars. It is reasonably certain that *animosus* is confined to the Upper Sonoran area east of the foothills. Chipmunks which I saw at Walsenburg were fully as dark as typical *quadrivittatus*, while Trinidad specimens more nearly agree with those from Archuleta and La Plata Counties in being more brightly colored than typical specimens and having the white dorsal stripes wider and purer white.

Eutamias hopiensis Merriam. Hopi Chipmunk.

This handsome species is represented from Colorado by a series of specimens from White River, near Angora; Rangely, 20 miles southwest; Evacuation Creek, north base of Book Plateau; Rifle; Dotsero, Grand River Canyon; McCoy; Somerset; Coventry; Uranium, Sinbad Valley; and Spruce Tree Cliff Ruins, Mesa Verde.

I first met with the Hopi chipmunk among the rocky bluffs at the ford of White River, near Angora, September 12, 1906. At this point fully a dozen were actively engaged in carrying oats from a stack along the river and storing them in caches among the rocky ledges near by. Numbers were seen among the White River bluffs as far west as Rangely, and thence the range is continuous across the rough juniper country to Dragon Junction, Utah, and southeast in the valley of Evacuation Creek to the north base of the Book Plateau, at 7,000 feet. This chipmunk doubtless occurs in all of the country between the Book Plateau and White River and west of Cathedral Bluffs. On the Book Plateau it was again found on the southern slope near Atchee, at 7,000 feet, which is very near the upper limit of junipers and pinyons. Thence it ranges south to Grand River and northeast in the Grand Valley uninterruptedly to the western end of Gore Canyon. It appears not to extend through this rugged gorge, however, as it was not found at Kremmling, Middle Park. It is very abundant in the lower valley of Plateau Creek, and occurs sparingly on the warm juniper slopes north of the Eagle River Valley nearly to Wolcott, where the Transition zone country proves an effective barrier to its eastward extension.

South of Grand River the Hopi chipmunk reaches its eastern limit at the following localities: Basalt, at the junction of the Frying Pan and Roaring Fork Rivers; Somerset, on the North Fork of the Gunnison; Crawford, on the Smith Fork of the Gunnison; pinyon slopes north of Dallas Creek, 5 miles west of Ridgway; Placerville,[1] on the San Miguel River; Cortez, in the Montezuma Valley; and the Spruce Tree Cliff Ruins, at the head of Navajo Canyon, which breaks to the south from the Mesa Verde into the canyon of Mancos River, a tributary of the San Juan. It was not found in the Durango region or at Arboles, and apparently does not follow the San Juan Valley east of the low divide extending south from the La Plata Mountains. In the warm valleys and canyons of western Mesa, Montrose, and

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[1] Warren, Further Notes on the Mammals of Colorado, p. 68, 1908.

San Miguel Counties *hopiensis* is abundant up to 7,000 feet, and was noted at the following localities: Coventry; Naturita Valley, 3 miles east of Naturita; Tabeguache Canyon, north of Nucla; west rim of West Paradox Valley up to the lower edge of the yellow pines, at 7,000 feet; Sinbad Valley and surrounding rim; Salt Canyon; Dolores Canyon to mouth of West Creek; and 4 miles up the valley of West Creek. It apparently does not extend through the northern end of the Uncompahgre Plateau in the Unaweep Canyon; and since at all other points the Canadian zone cap of this plateau is an effectual barrier, it must reach the Uncompahgre Valley, on the east side of the plateau, from the north, through the Grand and Gunnison Valleys.

The Hopi chipmunk is common in western and southern Montezuma County, where I have seen it in the McElmo Canyon at Ashbaugh's ranch and Moqui, and in the southern borders of the Mesa Verde. At the head of Navajo Canyon these chipmunks were abundant the middle of June. They frequented the cliffs along the warm side of the canyon during the early morning hours, and were usually seen running along the rocky ledges in the bright sunlight in family groups of four or five, the young being from half to two-thirds grown. About 9 o'clock the chipmunks usually disappeared and were not again seen until the following morning. A nursing female in worn pelage and a male in bright fresh summer coat were collected at this point.

Eutamias hopiensis was described from Keam Canyon, Painted Desert, Arizona, and is known also from Bluff City, Utah, and a number of localities in the San Juan Valley of northwestern New Mexico. Its range has not been worked out in detail, but is known to be in the desert canyons and pinyon and juniper country bordering the Colorado River and its tributaries from northern Arizona and northwestern New Mexico north to northwestern Colorado, mainly in the Upper Sonoran zone. It occurs in Colorado at few points above 7,000 feet.

As far as known the ranges of *E. hopiensis* and *quadrivittatus* meet at only one point in Colorado (see fig. 4). E. R. Warren collected both species in May, 1907, at Yarmany Creek, near McCoy, Eagle County, at an elevation of 6,900 feet,[1] and the specimens, which I have examined, show no evidence of intergradation. The two species occur in close proximity elsewhere. I have taken *E. quadrivittatus* at Sapinero and have seen *hopiensis* at Crawford.

In size and general appearance the Hopi chipmunk resembles *E. quadrivittatus* of the eastern foothills, but its movements are more deliberate and its colors much brighter and richer. The long tail is carried more nearly horizontally, even when the animal is running. This striking habit, together with the graceful downward curve of the tail near the tip, serves to distinguish it, even at a distance, from the small *E. consobrinus*, with which it commingles in the higher parts of its range. In the juniper country south of White River its habit of leaping up a tree when alarmed and hiding on the opposite side of a branch may cause it to be confused with the gray *utahensis*, which is found in similar country in the Escalante Hills. The Hopi chipmunks appear equally at home among the hot rocks in the precipitous canyons and in the dense juniper and pinyon growth which clothes the bordering mesas. They feed extensively upon the berries of *Juniperus monosperma* throughout their range.

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[1] Further Notes on the Mammals of Colorado, p. 68, 1908.

Eutamias amœnus operarius Merriam. Colorado Chipmunk.

Eutamias amœnus operarius Merriam, Proc. Biol. Soc. Wash., XVIII, p. 164, June 29, 1905. Type from Gold Hill, Boulder County, Colorado.

This chipmunk was formerly confounded with *quadrivittatus*, with which it occurs at many points in the eastern foothills of Colorado; but while the two are nearly alike in coloration, *operarius* is decidedly smaller, and its short, round skull and short nasals indicate affinities with a different group. The rump is usually ashy gray, while that of *quadrivittatus* is olivaceous. From *consobrinus* of the western mountains *operarius* may be distinguished by its more robust skull, although in summer pelage the two are sometimes almost indistinguishable externally. It is the highest ranging chipmunk in the State, occurring regularly far above timberline along the crest of the front ranges. It is found also as low as 6,500 feet at several localities in the eastern foothills, and E. R. Warren has recently shown me specimens taken by Robert B. Rockwell along the South Platte, 3 miles south of Littleton, at about 5,300 feet.

Although most abundant on the higher slopes of the front ranges, *operarius* is common in the mountains bordering the San Luis Valley and extends westward in the San Juan Mountains to Silverton and Lake City, where fairly typical specimens have been taken. A June specimen from the southeast base of Lone Mesa, west of the La Plata Mountains, seems referable to *operarius*, although the only other chipmunk taken at that locality is nearer *consobrinus*. A very brightly colored July specimen taken in the yellow pine country at the head of Dominguez Creek, on the Uncompahgre Plateau, is intermediate, resembling *consobrinus* externally. *E. operarius* was abundant in the high La Sal Mountains, Utah, west of the Paradox Valley, in July, 1907, at 11,000 feet, and was seen considerably above timberline. The chipmunks of the La Sal Mountains are entirely isolated from those of the Colorado mountains by a broad belt of Upper Sonoran desert country occupied, so far as known, by only *E. hopiensis*.

The extent of country over which the ranges of *operarius* and *consobrinus* overlap has not been worked out with precision. Both forms have been taken at Canadian Creek, at the west base of the Medicine Bow Range in North Park; at Coulter, Middle Park; and at Lone Mesa (9,000 feet), west of the La Plata Mountains. Chipmunks from Sapinero are typical *consobrinus*, while others from Lake City, 35 miles south, are *operarius*. Specimens collected above timberline on the Saguache Mountains at St. Elmo are, strangely enough, *consobrinus*, indicating that *operarius* is not found on the west side of the Arkansas Valley. Chipmunks taken by Warren on the head of Eagle River (near Tennessee Pass) are intermediate but nearest *operarius*.

Average measurements of five skulls of adult male topotypes of *E. operarius* are as follows: Occipito-nasal length, 32; basilar length, 24.6; zygomatic breadth, 18. Average of four skulls of adult male *consobrinus* from Canadian Creek, North Park: Occipito-nasal length, 31; basilar length, 23.5; zygomatic breadth, 17.2.

There are specimens of *operarius* in the Biological Survey collection from the following localities: Gold Hill, type locality; Estes Park; Longs Peak; Boulder, 5 miles west; Nederland; Golden; Idaho Springs; Cascade; Mount Kelso; Elkhorn; Livermore; Berthoud Pass; Canadian Creek; Coulter; Como; Lone Mesa; La Sal Mountains, Utah; Silverton; Lake City; Hermit; Cumbres; Antonito; and Fort Garland. Warren has specimens from Colorado Springs; Florissant; Tarryall Creek; Salida; Boreas Pass, 11,470 feet; Breckenridge; Poncha Pass; Herard; Querida; Crestone; and Tercio, Las Animas County.

Eutamias minimus (Bachman). Least Chipmunk.

Chipmunks from the Snake River Valley and the adjacent sage plains and from the Browns Park region along Green River agree well with typical *E. minimus* from Green River, Wyoming. In the region between Bear River and the Danforth Hills, *minimus* grades into the dark form *consobrinus* of the high mountainous country on the south and east. Four August and September specimens from Snake River (20 miles west of Baggs Crossing), Sunny Peak, and Ladore are typical *minimus*. Others from Lay, Axial Basin, and Lily show an approach to *consobrinus*.

The least chipmunk is one of the most characteristic mammals of the sage plains and appears not to range at any point much above 6,000 feet. During the latter part of August, 1906, numbers were observed in the Snake River Valley near Sunny Peak, Routt County. Some were in dry arroyos or on the level sage plain, but the majority were busily engaged in gathering a winter's supply of buffalo berries (*Lepargyrea argentea*), which were fully ripe in the dense thickets along the river. Near Ladore, in the Green River Valley, this chipmunk was often seen in the tops of *Sarcobatus* bushes. On the north slopes of the Escalante Hills it ranges up to the edge of the junipers and pinyons inhabited by the large gray *Eutamias utahensis*, but apparently does not enter the timber growth. This chipmunk may often be seen in the top of a sagebush, but unlike *E. consobrinus* is very wild and difficult to capture. When running, it holds its tail at right angles to the back. The tail then appears very long, but this may be partly due to the small size of the body.

Eutamias minimus caryi Merriam. San Luis Chipmunk.

Eutamias minimus caryi Merriam, Proc. Biol. Soc. Wash., XXI, p. 143, June 9, 1908. Type from Medano ranch, San Luis Valley, Colorado.

So far as known, this handsome ashy gray chipmunk is restricted to the eastern and northern central parts of San Luis Valley, where it inhabits the open *Sarcobatus* and *Chrysothamnus* plains. The original series of specimens from the Medano Springs ranch, east of the San Luis Lakes, consists of 8 males and 5 females collected October 24–29, 1907. In the summer of 1909 Warren found it at Moffat, Hooper, Mosca, and Crestone, thus considerably extending the known range. Chipmunks reported from the greasewood plains between Moffat and Saguache are doubtless the same form, and suggest a very general dispersion over the central part of the valley. At the time of my stage trip between these two points, November 6, 1907, the chipmunks had apparently retired to winter quarters. I heard of none at Alamosa or at any point in the open valley south of Mosca.

This chipmunk strongly resembles *E. minimus* of the Routt County sage plains, its nearest relative, as regards both wariness and appearance. When the animal is running, the tail is carried at a right angle to the back, and appears much longer in proportion to the body than measurements show it to be. At the Medano ranch these chipmunks were usually seen among the low sandy hummocks and ridges bordering the meadows, where the chico brush or chaparral of *Sarcobatus vermiculatus*, *Chrysothamnus patens*, and *Atriplex occidentalis* reaches its maximum growth, often from 6 to 8 feet in height, and affords suitable homes and retreats among the gnarled and many branched roots and basal stems which the drifting sands have left partially exposed. Most of my specimens were shot, but a few were caught in mousetraps. The chipmunks were out chiefly during the forenoon, and any time after sunrise on bright mornings could be seen in the tops of the chico brush busily storing the seeds in their cheek pouches, afterwards descending and caching them in the burrows, which were usually in the sand at the bases of the shrubs. One usually noted my approach at a distance of fully 50 yards, and, after hastily climbing to the top of a tall bush for a good look, would descend to the ground, sometimes silently, and again uttering excited, high-pitched notes. When the little fellow next appeared above the level of the chico it was generally in a tall bush fully 30 yards farther on. This maneuvering would be kept up for some time until a very large bush would conveniently intervene and afford sufficient cover to approach within range. The chipmunks were silent for the most part, and the alarm notes were heard only a few times. The notes are not loud, but are very high pitched, and quite unlike those of *quadrivittatus* and *operarius* of the foothills and mountains on both sides of the valley. The size, coloration, and habits readily distinguish this chipmunk from either of the above forms. Cowboys at the Medano ranch state that, in addition to the chico seeds, these chipmunks are very fond of the large roundish seeds of a honey plant (*Peritoma sonoræ*), locally known as skunk weed, which grows rankly on the dry sandy ridges extending through the meadows.

Eutamias caryi is characterized as follows (from original description, l. c.):

"*Characters.*—Similar to *minimus* but paler and grayer. In fall pelage (late October) pale gray, most marked on neck and rump, and almost as clear on inner pair of light stripes; outer pair of white stripes purer white than in *minimus*; pale face stripes whitish, in striking contrast with the alternating dark stripes.

"*Measurements.*—Type: Total length, 194; tail vertebræ, 87; hind foot, 30. Average of 10 specimens from type locality: Total length, 194; tail vertebræ, 89; hind foot, 30.2."

Eutamias minimus consobrinus (Allen). Wasatch Chipmunk.

This is the small, brightly colored chipmunk so abundant in the Canadian and Transition zones on the mountains and plateaus west of the Front and Medicine Bow Ranges and north of Grand River. It is present also on some of the plateaus and mesas of the southwestern counties, where it frequents the oak chaparral, ranging at least as far south as the Mesa Verde and Ute Peak. In eastern Middle and North Parks and on the western slope of the La Plata Mountains its range meets and slightly overlaps that of *operarius* and, as noted under *operarius*, both forms have been taken together at several localities. On some of the western plateaus *consobrinus* ranges a short distance into the pinyon belt of the Upper Sonoran zone, where over small areas in the Grand, White, and North Gunnison Valleys, and in the San Miguel region, it commingles with the large Hopi chipmunk (*E. hopiensis*). Toward the north, on the sage plains of Routt County, it grades into *minimus*. Its center of abundance is in the heavy forests of the Canadian zone, but it is common on the high sage plains of North Park, and even ranges into the greasewood in some of the warm Upper Sonoran valleys in the extreme western part of the State. It is especially numerous in the Gunnison region, on the White River Plateau, and in the mountains bordering North and Middle Parks, except on the east side.

E. consobrinus generally remains below the Hudsonian zone and, broadly speaking, it is not such a high ranging form as *operarius*.

Near St. Elmo, in the Saguache Mountains, however, it was tolerably common at timberline October 9, 1907, while down in the Chalk Creek Valley at St. Elmo (10,000 feet) none were noted. Most of the chipmunks seen were running actively over the snow banks in the ragged growth of foxtail pines (*Pinus aristata*) just below timberline. Seen at a distance on the bright snow banks, with their tails held erect, these chipmunks are striking little objects. Three specimens were shot at an altitude of 12,000 feet.

The sharp notes of this chipmunk are characteristic sounds in the depths of the aspen and spruce forests. Deserted cabins are especially frequented by them, and near a camp the chipmunks soon become tame and unsuspecting. In the latter part of September, 1906, from 20 to 30 could often be counted within sight of our camp at Baxter Pass, at 8,000 feet, on the Book Plateau, where they were busily gathering acorns. They were rarely observed during the middle of the day, being out chiefly in the early morning hours. In the high country the food consists largely of wild cherries, June berries, and snowberries (*Symphoricarpos oreophilus*). In the White River Valley in September they were feeding extensively upon buffalo berries (*Lepargyrea argentea*).

A large series of specimens from the following localities indicates the range of *consobrinus* in Colorado: Coulter; Sulphur Springs; Kremmling; Mount Whiteley; Arapahoe Pass; Canadian Creek; Pearl; Elk Head Mountains; Meeker; White River Plateau; Rangely; Evacuation Creek; Baxter Pass, Book Plateau; Gypsum; Sapinero; Somerset; Mesa Verde; and Lone Mesa.

Allen has recorded (as *Tamias quadrivittatus*) a series of 16 chipmunks collected by W. W. Granger at Three Forks (forks of Snake River, near Honnold) in 1895.[1] Specimens in the Biological Survey collection from 5 miles south of Honnold are *consobrinus*, and that Mr. Granger's series is referable to the same form is indicated by the small hind foot measurements given—29.5 to 30.7.

Eutamias dorsalis utahensis Merriam. Utah Chipmunk.

Fifteen specimens of this handsome gray chipmunk were collected in the dense juniper and pinyon growth on the northern slopes of the Escalante Hills, at Douglas Spring, early in September, 1906, but it was not taken elsewhere in western Colorado, although much of the region seems favorable for it. These chipmunks were abundant in the heavy growth of junipers and pinyons between 6,000 and 6,500 feet, and were found also in rocky ledges among the scattered yellow pines on the summits at 7,000 feet. Warren collected this species on Cross Mountain, east of Snake River, a few miles northeast of Lily, in 1907. This locality is some 20 miles east of Douglas Spring.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 256, 1896.

It is reported also from the eastern end of Yampa Canyon, a few miles west of Lily.

Eutamias utahensis was described from Ogden, Utah, and has not been previously taken much east of Provo in that State. It is an Upper Sonoran form and probably ranges eastward along the southern foothills of the Uinta Mountains, entering Colorado in the region of the Yampa Plateau, south of Bear River. Future work in northeastern Utah will determine whether there is continuity of range or the Colorado colony is entirely isolated.

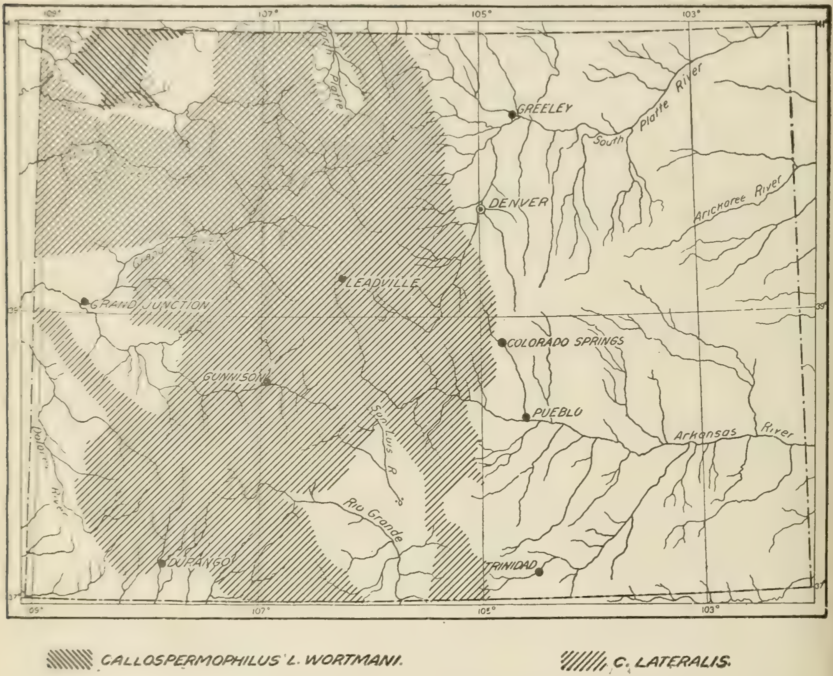
These chipmunks at Douglas Spring were remarkably wild, and it required much perseverance to secure my series of specimens, all of which were shot. The favorite feeding time was in the early morning and again just before sunset, when they were usually in the tops of junipers busily feasting upon the berries. I seldom managed to approach nearer than 30 yards without alarming them. When frightened they uttered a series of high-pitched notes, and after a hasty descent to the ground fled precipitately, rarely stopping within sight. The bushy tail is very prominent and gives the animal the appearance of a small squirrel, and this resemblance is heightened by the ease and rapidity with which it climbs trees and keeps on the opposite side from the observer. The seeds of the juniper berry appear to be the chief food, and they filled the cheek pouches of the specimens collected. Several caches of these berries were found in the hollow branches of junipers in which the chipmunks appeared to be living.

Callospermophilus lateralis (Say). Say Ground Squirrel.

S[ciurus] lateralis Say, in Long's Exped. Rocky Mts., II, p. 46, 1823. Type from Arkansas River (a few miles below present site of Canon City), Colorado.

The Say ground squirrel is a common and characteristic mammal throughout the mountains of Colorado in the Transition and Canadian zones. It is found from the eastern bases of the foothills to timberline and west of the main ranges occurs on all the timbered hills and plateaus to the Utah boundary. The Biological Survey collection is rich in specimens of this species from a great many localities over its range. *C. lateralis* is replaced in the rocky canyons and juniper country along Bear and Snake Rivers by a pale form, *C. l. wortmani*. Specimens from the Transition zone summits of the Escalante Hills, in extreme western Routt County, are nearest *lateralis*. Others from the White River Valley near Rangely are noticeably paler than typical specimens from the eastern foothills and approach *wortmani*. (See fig. 5.)

In the foothills near Boulder *C. lateralis* is most abundant in the yellow pine belt between 5,500 and 8,500 feet, but in crossing the mountains from Fort Collins to North Park it was first noted in the lower edge of the lodgepole pine belt a few miles northeast of Bald Mountain at 8,500 feet. From this point it was common across the Laramie Divide, Laramie Valley, and Medicine Bow Range to the edge of the sage plains of North Park. At Arapahoe Pass (Rabbit Ear Mountains), and on the White River Plateau, southeast of Meeker, *lateralis* was common in the aspen and lodgepole pine forests at 9,000 feet, and was especially numerous about clearings and among the charred stumps and logs in fire-swept tracts. Farther west, on the Book Plateau, it was common on the open rocky south slope as far down as Carbonera, at the edge of the Grand Valley, and was also observed in the valley of Evacuation Creek at the north base of the plateau.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PUEBLO
San Luis R.
Arkansas River
Rio Grande
Dolores River
DURANGO
TRINIDAD
▨ CALLOSPERMOPHILUS L. WORTMANI.
▨ C. LATERALIS.

FIG. 5.—Distribution in Colorado of golden-mantled ground squirrels (genus *Callospermophilus*).

In the southern part of the State the Say ground squirrel is most abundant in the Transition zone—in the extensive yellow pine forests at the southern base of the San Juan Mountains from Pagosa Springs west to Vallecito; on the Dolores and Uncompahgre Plateaus; and at the north base of the San Miguel Mountains, south of Norwood. It has a wide zonal range, however, from the lower edge of the pines to timberline, and at Mancos, at least, is abundant in the upper edge of the pinyon country. One was noted on a pinyon-clad slope a few miles west of Ridgway, Ouray County.

This ground squirrel usually lives in rocky ledges and among piles of bowlders, but in the heavy forests often digs its own burrow or takes up its abode in a hollow log or deserted cabin. In the sandy yellow pine country at the head of Dominguez Creek on the Uncompahgre Plateau it appeared to be living entirely in burrows, and in some places in the higher parts of its range it uses so constantly the tunnels of the mountain pocket gopher (*Thomomys fossor*) that it is continually getting into traps set for gophers. Near Cochetopa Pass Loring once found one living in a burrow which it had excavated in the earth roof of a cabin. It is fond of sunning itself in exposed situations during the warmer part of the day, and may often be seen sitting upright and motionless on a point of rocks, tree stump, or ridge pole of a cabin. The animals are rarely observed on cloudy days, and they do not come out so early in the morning as the chipmunks do, but await the warming rays of the sun. Several families of this species were living in the slide rock near the Stevens Mill, at timberline on Mount McClellan, in June, 1905. Each morning during my stay, at about 9 o'clock, they were busily feeding, in company with chipmunks and white-throated sparrows, on the oats left in the trail in front of the mill by the ore teams. At Estes Park, in August, 1894, Dr. A. K. Fisher found this species feeding extensively upon currants (*Ribes cereum*). In southern Colorado acorns form a part of its food. Warren states that near Querida it has been seen to kill a young bluebird in a nest in the bank of a gulch, apparently with the intention of eating it.

Near Georgetown, June 25, 1905, I saw a female and two young about a third grown romping among some loose rocks on the bank of Clear Creek. When the old squirrel first saw me she ran to the little ones and pushed them back into a hole among the rocks with her forefeet. As soon as she had left them the youngsters came out and began playing again. The mother returned and again pushed them into their safe retreat, appearing much excited at my presence. This was continued for a number of times, until I tired of watching the performance. Near Vallecito, June 5, 1907, the young were half or two-thirds grown, and two weeks later a great many young of about the same age were seen north of Dolores.

These ground squirrels go into winter quarters during October—at the higher elevations early in the month.[1] At McCoy, on Grand River, I noted only one, October 9, 1906, and on my return through Middle Park and over Berthoud Pass, from October 12 to 18, saw none. In 1907 the latest records were: One at St. Elmo (10,500), October 10; one at Sapinero (7,300 feet), October 16; and one east of Lake San Cristobal, San Juan Mountains (9,500 feet), October 18.

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[1] Warren writes me that he shot one at Colorado Springs Nov. 11, 1909, which is an unusually late record.

Streator found the species had hibernated at Gold Hill, October 27, 1894; while Warren states that it had disappeared for the winter at Crested Butte before October 8, 1905.[1] They are said to come out in spring before the snow is gone. On this point Warren observes: "While it disappears, in the Elk Mountains at least, with the first snowstorms in early October, it comes out in the spring before the snow is gone. I have known it to tunnel through 3 feet of snow to get to the surface. A specimen taken early in April under such circumstances was very fat."[2]

Callospermophilus lateralis wortmani (Allen). Wortman Ground Squirrel.

This pale form, described from Kinney ranch, Sweetwater County, Wyoming, inhabits the rough bad-land region which borders the lower Snake and Bear Rivers in western Routt County, and, so far as known, is restricted to this low arid Upper Sonoran country and the adjoining desert areas of Wyoming. (See fig. 5.) Specimens from the plateaus and mountains to the east, south, and west, in the Transition zone, are referable to *C. lateralis*; but, as noted under that species, specimens from near Rangely, in the Upper Sonoran area of the White River Valley, although referred to *C. lateralis*, are paler and approach the present form.

A specimen of *C. wortmani* from the northern edge of Routt County, 20 miles southwest of Baggs Crossing, Wyoming, August 26, 1906, was taken in a trap set for wood rats among the scattering junipers which clothed the steep southern face of a rocky bluff on the north side of Snake River. This was the only one seen on my journey down the Snake River Valley in 1906, and the animals appeared to be rare. Another very pale individual, which appeared to be this form, was seen a few days later, however, among the bluffs on the north side of Bear River, near the mouth of Sand Creek, a few miles below Maybell. Near Lily, at the confluence of the Snake and Bear Rivers, this squirrel was said to be abundant. Several specimens from the Snake River bluffs, 7 miles north of Lily, collected by Warren in the summer of 1907 and sent to the Biological Survey for identification, are clearly referable to *wortmani*. Warren says the animals were tolerably common at this point, but I saw none while encamped at the same place the previous year.

Ammospermophilus leucurus cinnamomeus (Merriam). Antelope Squirrel.

The antelope squirrel is found in the warm desert areas of western and southwestern Colorado below 6,000 feet, chiefly in the valleys of the streams tributary to the Colorado and Green Rivers. There are specimens at hand from White River, 20 miles east of Rangely; Rangely; Fruita; Grand Junction; Hotchkiss; Coventry, 6,400 feet; and Ashbaugh's ranch, near McElmo. The northward dispersion is limited by the Yampa Plateau, between White and Bear Rivers. (See fig. 6.)

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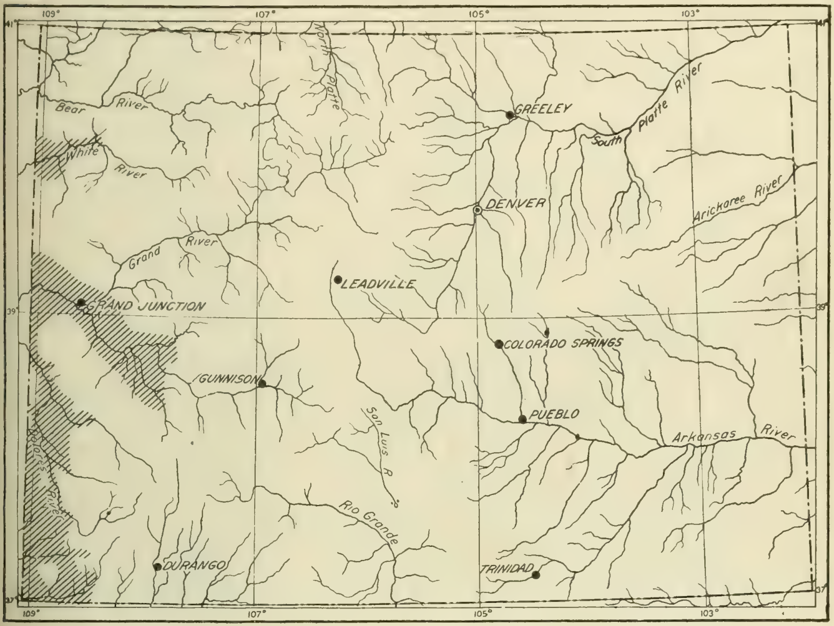
[1] Mammals of Colorado, p. 241, 1906.

[2] Ibid, pp. 240-241, 1906.

In 1906 antelope squirrels were first met with in the White River Valley at the ford east of Angora, and from this point to the Utah boundary they were common among rock ledges along the river. In crossing the country between White and Grand Rivers we saw them until we were 10 miles southwest of Rangely, and not again until we reached Carbonera, at the southern base of the Book Cliffs. On the desert between Carbonera and Mack, and thence up the Grand River Valley to Palisade, the antelope squirrel is an abundant and characteristic mammal. It was not noted at any point in the White and Grand Valleys above 5,500 feet.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GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD

FIG. 6.—Distribution in Colorado of antelope squirrel (*Ammospermophilus leucurus cinnamomeus*).

East of the Uncompahgre Plateau the species ranges over a considerable area in the Gunnison and Uncompahgre Valleys. Mr. C. H. Smith, of Coventry, states that he has seen several at the eastern base of the plateau, southwest of Montrose. In the valley of the North Fork of Gunnison River it occurs east to Hotchkiss and probably to Paonia. In August, 1907, I found these squirrels tolerably common on the open rocky slopes north of the river at Hotchkiss, but did not see any near Crawford, at the base of the West

Elk Mountains. A skin in the National Museum, collected by Capt. James Stevenson September 18, 1873, labeled "Elk Mts.," probably came from some point at their western base.

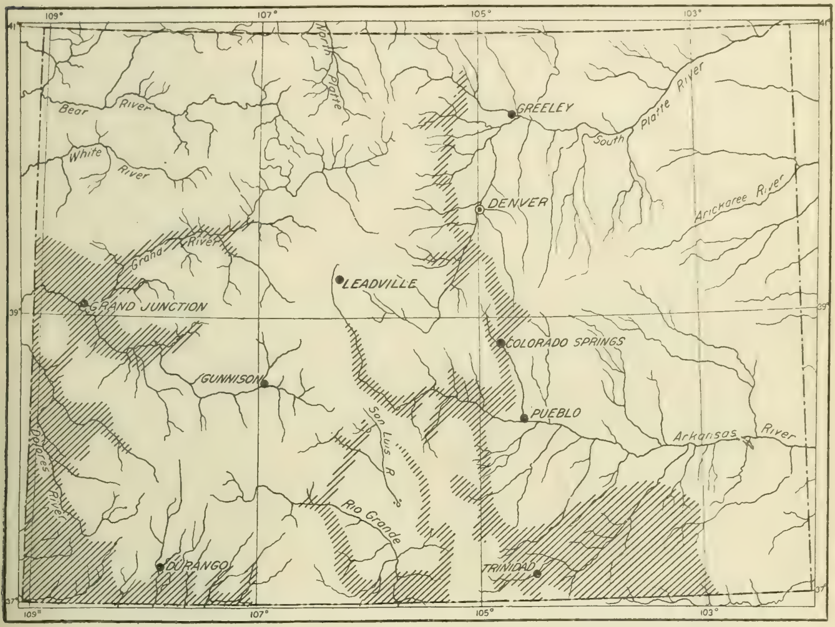
The antelope squirrel is rather generally distributed in the warm valleys of southwestern Colorado. In Montezuma County it was not found at Mancos, but a single individual was seen on an *Atriplex* flat at the north base of Mesa Verde, a little west of Point Lookout, which appears to be the eastern limit. It is abundant along McElmo Creek, both among the rocky ledges in the canyon and on the lower bordering mesas. In the region of the lower San Miguel and Dolores Rivers the species is restricted to the hottest valleys and slopes, and was noted as follows: Naturita west to Dry Creek; Salt Canyon, outlet of Sinbad Valley; canyon of Dolores River, Salt Canyon to mouth of West Creek; and West Creek Valley to 4 miles above mouth. It does not extend through the Unaweep Canyon to connect with its range in the Gunnison Valley. Mr. William Boren, of Norwood, says antelope squirrels are common in Dry Creek Basin in Gypsum Valley, and on lower Disappointment Creek in western San Miguel County. The above localities indicate a general distribution below 6,000 feet.

Antelope squirrels frequent sandy arroyos and are striking objects as they frisk about in the morning sunshine with the pure white under surface of the upraised tail showing prominently. They are easily alarmed and retreat precipitately to the burrows, which are usually in the sandy bank of a dry desert wash or beneath sage or *Atriplex* bushes. In a few moments the animal may be watching the intruder from the mouth of a burrow or from behind a pile of rocks, but it disappears at the slightest noise or movement. At Fruita, Mesa County, several were living in the cemetery, and one or two burrows were found beside gravestones. None of the squirrels uttered a sound while under my observation, but one which J. Alden Loring heard near Grand Junction had a note described as "loud, shrill, and rattling, and gradually dying out like a policeman's whistle." Mr. Loring states that the antelope squirrel has from four to six young in a litter. Mr. George J. Ashbaugh and other ranchmen between Moqui and McElmo, Montezuma County, state that antelope squirrels do much damage in the spring by digging up newly planted corn. During my stay at Mr. Ashbaugh's ranch, June 18–23, 1907, the young were about two-thirds grown, and proved a nuisance by getting into traps placed at the mouths of *Perodipus* burrows on the small sandy flats at the base of the rocky canyon walls. The species is more or less active in winter, as Mr. C. H. Smith, of Coventry, has taken it in January.

Citellus variegatus grammurus (Say). Rock Squirrel.

> *Sciurus grammurus* Say, in Long's Exped. Rocky Mts., II, p. 72, 1823. Type from Purgatory River, near mouth of Chacuaco Creek, Las Animas County, Colorado.

The large gray rock squirrel is common among the rock ledges of the eastern foothills, and also throughout the warm valleys of southern and southwestern Colorado north to the southern base of the Book Cliffs mainly in the Upper Sonoran zone. East of the mountains it is not known to extend north to the Wyoming line, but is found in the foothills west of Fort Collins. Along the eastern slope of the mountains it occurs regularly in open, rocky situations up to 7,000 feet, and toward the south is occasionally found to 8,000 feet. In the Grand River Valley the upper limit appears to be at 6,500 feet, a little below the upper edge of the juniper and pinyon belt. In some of the southwestern valleys, however, it ranges considerably higher, and on the southwestern slopes of the Uncompahgre Plateau extends well into the yellow pine belt wherever suitable rocky ledges occur. (See fig. 7.)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San Luis R
Arkansas River
Dolores River
Rio Grande
DURANGO
TRINIDAD

FIG. 7.—Distribution in Colorado of rock squirrel (*Citellus variegatus grammurus*).

The Biological Survey has specimens of *grammurus* from Higbee, Otero County, which are practically topotypes. Specimens from both eastern and western slopes are fairly typical, those from western Colorado not differing sufficiently to be referred to *C. v. utah*, described by Dr. Merriam from Ogden, Utah. Rock squirrels which I saw in the Grand River Canyon above Glenwood Springs in October, 1906, appeared quite reddish on the back, however, in this respect suggesting the Utah form.

Rock squirrels nearly always live in rocky situations, the ledges and bowlder-strewn sides of canyons, the bare rocky slopes along the base of the foothills, and the rim rock of outlying mesas and buttes being especially frequented. In the pinyon country near Bayfield, La Plata County, their burrows were often found along the margins of fields in a nearly level country. As a rule, however, the burrows are located beneath bowlders at the base of a rocky canyon rim or in rock slides. Rock squirrels are quite shy and wary, and when one is surprised in the bottom of a canyon, as is often the case, it invariably runs up the slope and takes refuge among the rocks above. If the observer remains perfectly quiet, he may at length detect the animal peering silently over the top of a large bowlder, but it generally vanishes at the slightest noise or motion. I watched one of these squirrels dusting itself near Bayfield. Apparently it was unaware of my presence and at intervals would run to a dusty spot in a path, throw the dust up with its fore feet, turn on its back, and wriggle and squirm along the ground in the greatest enjoyment. This performance was repeated a number of times, when suddenly the little fellow spied me and raced off through the brush.

The food of rock squirrels consists chiefly of pinyon nuts, acorns, and juniper berries, and consequently over much of their range the animals do little damage. In some sections, however, they are reputed to show a fondness for young chickens. Rock squirrels are abundant in the McElmo Valley, Montezuma County. Mr. George J. Ashbaugh states that they destroy many apricots on the trees for the sake of the seeds, of which they are especially fond;[1] they eat holes in cantaloupes and watermelons on the vines in search of the seeds, which they carry into the rocks to be eaten at leisure; and they also dig up and eat much newly planted corn.

While at Ashbaugh's ranch in June, 1907, I often heard the sharp alarm notes of rock squirrels in the orchard back of the house. Near Coventry in July they were feeding extensively upon pinyon nuts. In Grand Valley, near Glenwood Springs, in October, 1906, numbers were seen in the tops of large pinyons busily feasting upon the nuts, and so common is this habit in that section that the animals are locally known as gray tree squirrels.

There are few data at hand on the breeding of *C. grammurus*. An old female collected by Loring at Lyons, May 28, 1893, was heavy with three large fetuses; while the young squirrels were about half grown at Ashbaugh's ranch, June 19, 1907.

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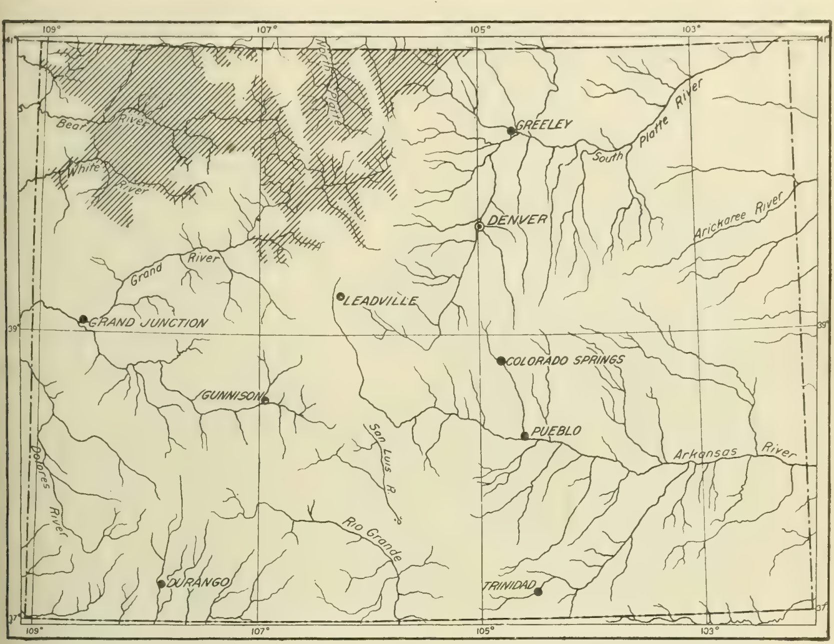
[1] Warren (The Mammals of Colorado, p. 163, 1910) states that a rock squirrel which was killed at Ashbaugh's ranch in the fruit season had 50 or more apricot pits in its pouches.

Citellus elegans (Kennicott). Wyoming Ground Squirrel.

This large gray ground squirrel is common in the mountain parks and on the sage plains of the northwestern part of the State. It does not appear to range south of the valley of Grand River, and it occurs east of the main ranges only in the Laramie River country. (See fig. 8.) It is abundant in Middle and North Parks, ranging across the Rabbit Ear Mountains at Arapahoe Pass (9,000 feet), and doubtless at other points where there is sufficient open country. In crossing the Medicine Bow Mountains west of Glendevey I did not meet with this squirrel, and assume that its range extends from North Park around the north end of the Medicine Bows into the Laramie Valley. A specimen in the National Museum from Cameron Pass, at 10,000 feet, was probably taken on the North Park side. The species was observed in the small parks along the heads of watercourses on the high forested divide east of the Laramie River as high as 10,300 feet, and extends east to Log Cabin and Fish Creek,[1] Larimer County, which points are near its eastern limits. In Routt County it is found everywhere except in the higher Elk Head and Williams River Mountains, the Escalante Hills, the Yampa and O-wi-yu-kuts Plateaus, and the higher western slope of the Park Range. Several of these ground squirrels were observed about 10 miles northwest of Hahns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GUNNISON
San Luis R.
PUEBLO
Arkansas River
Dolores River
Rio Grande
DURANGO
TRINIDAD
37°

FIG. 8.—Distribution in Colorado of Wyoming ground squirrel (*Citellus elegans*).

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[1] Bailey, Spermophiles of Mississippi Valley, Bull. No. 4, Biological Survey, p. 60, 1893.

Peak, which appears to be near its eastern limit in the Snake River country. It ranges to the headwaters of Bear River, in Egeria Park, thence south to McCoy, on Grand River, and south across the Piney Divide to Wolcott. The heavily forested Gore Range, east of Egeria Park, apparently proves a barrier, although the species is common in the parks on its western slope 8 miles east of Toponas. In the Eagle River Valley I found *C. elegans* tolerably common from Gypsum to Wolcott, and Warren reports it present to a point 3 miles east of Minturn, while in the valley of White River it occurs from Buford west as far as Rangely. From Meeker the range is north across the Danforth Hills to Axial Basin, south in the valley of the Piceance to Rio Blanco,[1] and from Angora north to Lily, on Bear River.

The sage flats in Middle and North Parks are densely populated with these ground squirrels, and ranchmen consider them very injurious to the cattle range and to small grain. Judging from my own observations the damage inflicted is by no means slight, and when the large territory inhabited by them is considered, it must be very considerable. During July I often saw numbers in the rye fields eating the green stalks, and not a vestige of grass remained near their burrows. Ranchmen in the Snake River Valley between Honnold and Slater claim that this species destroys fully a third of the rye crop, pulling down the stalks to get at the heads, and the appearance of the small fields in August, 1906, fully sustained their statement. In the summer of 1904 a 5-acre field of oats on Little Bear Creek, a tributary of Fortification Creek, is said to have been utterly ruined by ground squirrels. In North Park I often saw them in the hay meadows, whither they resort in the early morning, busily engaged in pulling down and eating the tall grass stems.

This species hibernates very early in the autumn. In 1905 none were observed at Lay August 3, and Mr. A. G. Wallahan informed me that they retired to winter quarters about the middle of July, although in the lower Snake River country they usually remain active until about August 1. August 17, 1906, a few were out near Honnold, but the majority were already in hibernation. An immature specimen was taken in a trap set in the underground tunnel of a pocket gopher near Baggs Crossing August 24, but none were noted above ground. A very few were seen near Meeker August 12, 1905. At Sulphur Springs, Middle Park, Warren found these squirrels running about in fresh snow on stormy days in April, and they probably come out of hibernation somewhat earlier at the lower elevations. I noted a great many burrows which had been opened by badgers, which appear to feed extensively upon this species—a fact well worth noting by farmers and stockmen.

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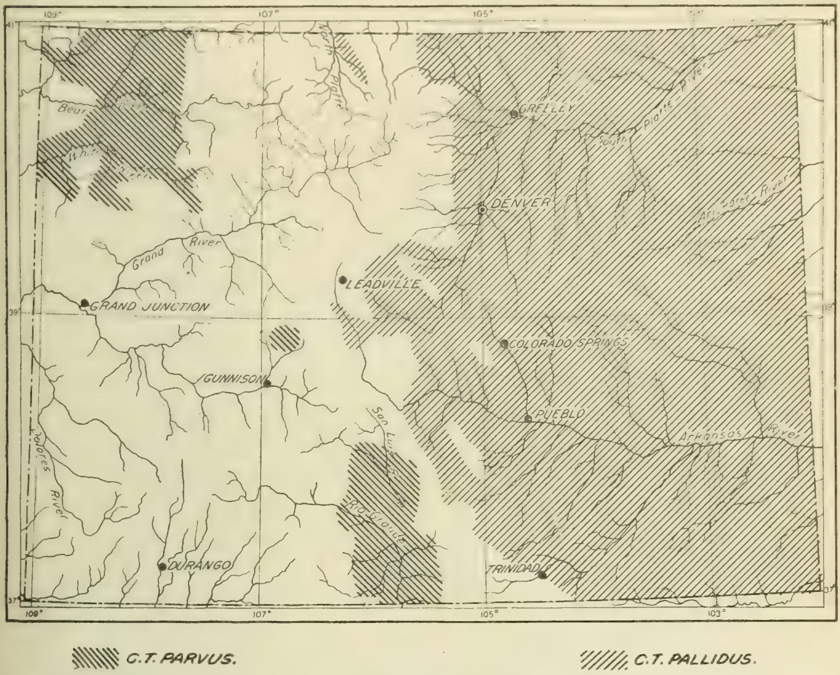
[1] Specimen in U. S. National Museum.

Citellus tridecemlineatus pallidus (Allen). Pale Striped Ground Squirrel.

This is the common striped ground squirrel of the plains, but it is found also in some of the mountain parks on the eastern slope of the mountains at an elevation of over 9,000 feet. It occurs also sparingly in North Park. It is replaced on the sage plains and in the mountain parks west of the Continental Divide, and also in the San Luis Valley, by another form of the same group—the little *C. t. parvus*. (See fig. 9.) Specimens from Loveland, Sterling, Pawnee Buttes, Tuttle, Eureka Hill (Cheyenne County), Las Animas, and other localities indicate a general distribution over the plains of eastern Colorado.


109°
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Bear
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LEADVILLE
GREELEY
South Platte River
DENVER
Arikaree River
GUNNISON
COLORADO SPRINGS
PUEBLO
Arkansas River
San Luis
Rio Grande
Dolores River
DURANGO
TRINIDAD
C.T. PARVUS.
C.T. PALLIDUS.

FIG. 9.—Distribution in Colorado of striped ground squirrels (*Citellus t. parvus* and *C. t. pallidus*).

At Golden the pale striped ground squirrel is common both on the plains and in the parks of the foothills at 7,300 feet. One was found dead in the trail near Elkhorn, in the foothills of Larimer County, at 7,500 feet. In North Park small numbers were occupying an isolated strip of sandy country east of Canadian Creek, at the west base of the Medicine Bow Range. *C. pallidus* has doubtless reached this region from the north, as the Medicine Bow Range is an effective barrier on the east. It was not observed on the sage plains of central and western North Park. It is common in the Wet Mountain and Huerfano Valleys, and near La Veta in the Cucharas Valley; and on August 23, 1907, I found it abundant and active on the high grassy plains of South Park near Como, at an elevation of 9,800 feet. It is reported also from the upper Arkansas Valley near Buena Vista, but I did not find any at Salida. The National Museum has a specimen from Twin Lakes. The species probably reaches the upper Arkansas Valley from South Park through some of the open mountain passes.

Over most of its range this ground squirrel is injurious to truck gardens and grain fields. Its worst habit is that of digging up newly planted corn and eating the kernels. Near Valmont, Boulder County, in June, 1905, it was reported very injurious. Because of its depredations several farmers were obliged to plant their sweet corn a second time. In this section it was living in burrows along the grassy margins of gardens and cultivated fields.

Citellus tridecemlineatus parvus (Allen). Little Striped Ground Squirrel.

This ground squirrel, the smallest member of the group, has its center of abundance in the semidesert areas of western Routt and Rio Blanco Counties. (See fig. 9.) This region was traversed so late in the summer, in both 1905 and 1906, that most of the squirrels were already hibernating; therefore their numbers could not be ascertained. The few observed were living in deserted burrows of white-tailed prairie dogs, with the exception of three in the White River Valley, which were occupying small burrows apparently excavated by themselves. The squirrels collected were sluggish in their movements and extremely fat, which indicated that they were ready for hibernation. They were usually sitting at the mouths of the burrows enjoying the warm autumn sunshine, but near Rangely one was seen in the top of a *Sarcobatus* bush. At Mud Springs, on the White River Plateau at 9,000 feet, *C. parvus* was occupying deserted burrows of *Thomomys fossor*. Two adults and two young were observed in a park at this point August 18, 1905. This squirrel is reported as common in Lily Park, at the confluence of the Snake and Bear Rivers; in Browns Park, near the Utah boundary; and on the Iron Springs Divide, between the Snake and Bear Rivers. In the Snake River Valley it is found as far east as the mouth of Four-mile Creek, where one was seen August 22, 1906. Warren states that he saw it at Big Beaver Creek, Rio Blanco County, in 1907.[1] During my investigations six specimens were collected, as follows: Axial Basin, August 8, 1905; Mud Springs, White River Plateau, August 18, 1905; Escalante (7 miles west), August 31, 1906; and Rangely, September 13 and 17, 1906.

This little ground squirrel is the form occurring over most, if not all, of the San Luis Valley. Loring found it not uncommon at

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[1] Further Notes on the Mammals of Colorado, p. 71, 1908.

Fort Garland in July, 1892, and collected three specimens, while Mr. J. H. Gaut secured two at Antonito, Conejos County, August 30 and 31, 1904. Bailey has observed this ground squirrel at La Jara, and it was reported to me as abundant at the Medano Springs ranch, near the San Luis Lakes, in 1907. While in the San Luis Valley in 1909 Warren found it at Mosca, San Luis Lakes, and at Moffat.

Nothing is known of the distribution of *C. parvus* in the region between the White River Plateau and the San Luis Valley aside from a specimen in the U. S. National Museum labeled "Elk Mts.," collected by Capt. Stevenson September 6, 1873.

Citellus obsoletus (Kennicott). Kennicott Ground Squirrel.

This is the small grayish ground squirrel inhabiting the sandy areas on the plains north of the Arkansas Divide. It does not appear to be present on the higher plains, being found principally in the valleys of the Platte and Republican Rivers and their tributaries. The western limits of range have not been ascertained. A specimen in the Colorado Historical and Natural History Society collection was taken at Sand Creek, near Denver, and the Biological Survey has the species from Greeley. Specimens from Hugo, Tuttle, Wray, Sterling, Avalo, and Greeley are referable to *C. obsoletus*, although there is considerable variation. Specimens from Wray and Tuttle have the coloration of *obsoletus*, but in size approach *major*. The Sterling series agrees best with specimens of *obsoletus* from Cherry County, Nebr. (assumed to be typical), in small size and in coloration, most of the specimens having the characteristic coal-black edgings of the indistinct spots on posterior part of dorsum.

Like most other forms of spotted ground squirrels, *C. obsoletus* is largely restricted to sandy country. In starting northwest across the plains from Cheyenne Wells in 1909, I first saw the species on the level plain a few miles northwest of that point May 10. No others were found until I reached the South Fork of Republican River, where an adult male was shot 5 miles east of Tuttle May 18. The following day another was collected on the hard soil divide 2 miles south of Wray, and one was noted in the sand 2 miles east of the same point. Mr. W. E. Wolfe, of Wray, informed me that in the valley east of the town these squirrels are more numerous than the striped ground squirrels. May 24 a spotted ground squirrel was seen in the sand hills midway between Wray and Yuma. I saw none in crossing the hard soil watershed between Yuma and Sterling. The species was encountered 6 miles southeast of Sterling May 28, one being trapped in a gravelly arroyo just below the bluffs, and others were taken in the sand along the east side of the Platte at Sterling a day or so later. The only one found northwest of Sterling was dug out of its burrow on a hard soil flat along Horsetail Creek, 13 miles east of Avalo, June 3. Prof. Lantz found these ground squirrels common south of the Big Sandy near Hugo. A burrow which he dug out in sandy soil was 12 feet in length, but at no place more than 18 inches below the surface. This burrow had three entrances and terminated in a small round chamber which contained a slight nest of grass, in which, instead of a squirrel, a large bull snake was coiled.

Citellus spilosoma major (Merriam). Large Spotted Ground Squirrel.

Spotted ground squirrels from the Arkansas Valley and southward, though not typical, are referred to this form. Specimens from Las Animas and La Junta (18 miles south) in the Biological Survey collection agree in size with typical *major* from Albuquerque, New Mexico, but are grayer. Others collected by Warren at Lamar and at Monon, Baca County, are best referred to this form. These are said to be the common ground squirrels in the Arkansas Valley at Pueblo.[1] Spotted ground squirrels from the Arkansas Divide and northward are nearest *obsoletus*, indicating that the two forms may intergrade in southern Colorado. Prof. D. E. Lantz, who collected specimens south of La Junta, thinks this form comes out of hibernation about April 20.

Cynomys ludovicianus (Ord). Prairie Dog.

This is the large brown prairie dog of the eastern plains of Colorado. There is probably not a county east of the foothills in which it is not present in considerable numbers, and colonies are found in some of the broader foothill valleys to an elevation of 6,000 feet. The western limit of range may be roughly indicated by Livermore, Larimer County; Lyons; Boulder; Rockvale, Fremont County;[2] Badito, Huerfano County; and Trinidad.

At several points in southern Colorado the range of this species almost meets that of the smaller *C. gunnisoni*, but usually the two species are separated by a vertical distance of from 1,000 to 2,000 feet—*ludovicianus* occupying the valleys and the flat tops of the lowest mesas, while *gunnisoni* lives in the parks of the highest foothills and in the mountains. Near Badito colonies of both species are found within a mile or so of each other—*ludovicianus* occupying the flat along Huerfano River, and *gunnisoni* the open parks among the pinyons on the first benches south of the river and only a few hundred feet above it. At Gardner, 12 miles above Badito, *gunnisoni* is found in the Huerfano Valley.

Prairie dogs are especially abundant along the Santa Fe Railroad between Trinidad and La Junta, and in Baca County in the extreme southeast corner of the State. In 1909 I found them common on the eastern end of the Arkansas Divide near Cheyenne Wells, and again from a point 15 miles northwest of Sterling west to Grover. Their numbers are decreasing in Yuma County and elsewhere, owing to rapid settlement. Numerous grass-grown mounds between Yuma and Sterling indicate that formerly the animals were abundant, but in 1909 I saw very few inhabited colonies in this section. In the thinly settled grazing country dog towns often cover large areas of excellent cattle range and are thus a source of loss to stockmen.

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[1] Warren, Mammals of Colorado, p. 242, 1906.

[2] Field Col. Mus. Pub. 115, Zool. ser., VIII, p. 181, 1907.

In 1892 Dr. A. K. Fisher found this species abundant at Trinidad in open places among the pinyons on the table mountains, and reports that at Las Animas nine prairie dogs were drowned out of a single burrow. In 1905 Prof. Lantz reported a colony at Byers in which albinos are common, stating that "a dozen pure white specimens can sometimes be seen at a time." Near Higbee, Otero County, Prof. Lantz reports that all the females had apparently given birth to young before April 12, 1910. In six instances the number of young was six; in two instances it was four.

Cynomys gunnisoni (Baird). Gunnison Prairie Dog.

Spermophilus gunnisoni Baird, Proc. Acad. Nat. Sci. Phila., VII, p. 334, 1855. Type from Cochetopa Pass, Saguache County, Colorado.

The type of *Cynomys gunnisoni* was collected by F. Kreuzfeldt on Capt. E. G. Beckwith's expedition in 1853. The species is considerably smaller than *C. ludovicianus*, with very short ears and tail, the latter bordered and tipped with white. Like *C. leucurus* of northwestern Colorado, it does not seem to be of marked gregarious habits, the burrows being scattered here and there over valleys, mesas, and even steep slopes. It is more of a mountain animal than either of the above species, but is equally at home in the Upper Sonoran, Transition, and even lower Canadian zones.

This is the prairie dog so abundant in South Park, in parts of the upper Arkansas, San Luis, and Rio Grande Valleys, and in the open country and valleys south and west of the San Juan and La Plata Mountains and the Uncompahgre Plateau. It crosses the Cochetopa Pass into the Gunnison country and ranges as far west as the Black Mesa. The northern and western limits are indicated by localities as follows: Como (South Park), Twin Lakes, Leadville, near Crested Butte,[1] Black Mesa, Cerro Ridge, and the Uncompahgre Plateau. The ranges of *gunnisoni* and *leucurus* do not seem to meet at any point, although separated by only a very narrow strip of country in the Cimarron region. *C. gunnisoni* is known to inhabit the lower western parts of Montezuma, Dolores, San Miguel, and Montrose Counties, and doubtless extends westward some distance into eastern Utah, possibly in that region also approaching the range of *C. leucurus*.

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[1] Further Notes on the Mammals of Colorado, p. 71, 1908.

Prairie dogs are reported abundant on the extensive sage flats and deserts south of the La Sal Mountains, but the species is not known.

In crossing the Continental Divide between Lake City and Creede, *C. gunnisoni* was not noted south of Lake City, but was again seen on the flats just below Lake Santa Maria, at 9,400 feet, and it may occur still farther up the Rio Grande Valley. The range is continuous across the Poncha Pass, between the San Luis and Arkansas Valleys, and also across Trout Creek Pass, between the Arkansas Valley and South Park. To the east this species is common in the small mountain parks near Divide, Teller County, at 9,500 feet, and extends down the Fountain Creek Canyon to Cascade. It follows the Arkansas River down to Texas Creek and thence extends south across the Wet Mountain Valley to the Huerfano, and down this valley to Badito. It occupies the divide between the Huerfano and Cucharas Rivers, and from near La Veta apparently follows southeast around the Spanish Peaks, as it is again met with on the parks and plateaus of the Trinidad region. In open sections like South Park, it reaches its upper limit at between 9,500 and 10,000 feet, but the vertical range is governed entirely by the character of the country. Thus on the southern slopes of the San Juan Mountains in Archuleta and La Plata Counties, where there is an extensive area of yellow pine forest between 7,000 and 8,500 feet, prairie dogs are not found so high, along the Rio Pinos occurring only as far up as Vallecito, at about 8,000 feet.

As the higher part of its range is a region of very limited agriculture and supports an abundance of wild grasses, this species can not there be considered very injurious, but in some of the low irrigated valleys of the southwestern counties it is very destructive to grain and alfalfa fields. On the South Park plains, just east of Como, in August, 1907, the heads of prairie dogs could be seen sticking out of the tall grass in all directions, but grass was so abundant that they were making no visible impression upon it. The greatest damage caused by prairie dogs was reported from Coventry, the McElmo Valley, and near Bayfield. At the last two localities the ranchmen successfully drown them out of all the low ground which can be reached with ditch water; but on the neighboring benches and mesas, and even on the largest dry knolls in the fields, the prairie dogs more than hold their own, as comparatively few ranchmen take the trouble to poison those left on high ground. Several ranchmen at Bayfield have for several years kept their land clear of prairie dogs by the use of carbon bisulphide or wheat soaked in strychnine, but a lack of cooperation permits the animals to maintain their present abundance. In a single pasture in the Rio Pinos Valley 181 prairie dogs are said to have been drowned out and killed in a single day. Old residents at Bayfield state that 15 years ago the animals were unknown in the valley, but that they have gradually worked northward with the cultivation of the land. According to Mr. C. G. Bates, of Bayfield, a peculiar disease killed the larger part of the prairie dogs on Florida River some years ago. The affection is said to have caused excessive weakness, and in its later stages loss of hair.

This species appears to hibernate throughout the winter. It was out in abundance at Divide, and also on the South Park plains between Howbert and Hartsel, October 5, 1907, and all of the animals appeared fat, sleek, and well furred. At Sapinero two were seen out of their burrows October 16, but none thereafter, although I was in good prairie-dog country until mid-November.

Cynomys leucurus Merriam. White-tailed Prairie Dog.

This handsome species replaces *C. ludovicianus* and *gunnisoni* on the sage plains of northwestern Colorado, where it occupies much of the open country west of the Park and Gore Ranges and north of the lower Gunnison Valley. It occurs also in North Park, but I did not find it in Laramie Valley, east of the Medicine Bow Range, nor does it range across the Rabbit Ear Mountains into Middle Park and Blue River Valley. In Snake River Valley it is found east to Honnold, and in White River Valley it is common as far up as the mouth of South Fork. Prairie dogs occur throughout the Bear River region, and follow this stream to its headwaters in Egeria Park; thence, sparingly, south across the divide to McCoy on Grand River, and again across Piney Divide to Wolcott, on Eagle River, and west in the Grand Valley to Gypsum. They do not extend through the Grand Canyon above Glenwood, nor do they pass around it, and they are absent from the Grand Valley between Glenwood and Grand Junction. On the desert areas between Grand Junction and the Utah boundary, prairie dogs are common, doubtless coming in from the west, where the range is probably continuous around the western end of the Book Cliffs in Utah. They range from the Axial Basin south across the lowest passes of the Danforth Hills to the White River Valley at Meeker, but apparently do not cross the White River Plateau or its western extension, the Book Plateau, at any point in the State.

Instead of extending northeast from Grand Junction in the narrow Grand Valley, *C. leucurus* ranges to the southeast in the broad Gunnison and Uncompahgre Valleys, and occurs over a wide area between the Grand Mesa and Uncompahgre Plateau. In the Uncompahgre Valley it was noted south to a point on Dallas Creek, a few miles west of Ridgway. East of Montrose it was abundant along the railroad at Cedar Creek, and a few were seen almost to the summit of Cerro Ridge, between Cedar Creek and Cimarron. None were observed at Cimarron, and the divide between the Cimarron and

Uncompahgre Rivers appears to mark the eastern limit of range in this region. The species extends east along the North Fork of the Gunnison to Hotchkiss and Paonia, and was abundant at the west base of the West Elk Mountains, between Hotchkiss and Crawford. The majority observed in this section were on the dry adobe flats, where the only vegetation worthy of mention was the prostrate, scrubby, desert-growing *Atriplex nuttalli* and a sparse growth of *Dondia* (probably *D. moquini*) in damp alkaline spots.

C. leucurus is not unlike *gunnisoni* in size and general coloration, but may be readily distinguished from the latter by its white tail and by the broad dusky patch which covers the eye and extends down over the cheek. It is not extensively colonial, the burrows being scattered here and there over the sage plains. The burrows are apparently occupied for many years, and the ejected earth accumulates into very large mounds, often as much as 3 feet in height and 8 or 10 feet in diameter. These prairie dogs are not very shy and often sit at the mouth of the burrow until approached within a rod. The usual note is a peculiar querulous cry, very unlike the short, sharp bark of *ludovicianus*. Chattering alarm notes also are occasionally heard as one walks through a colony.

Wherever white-tailed prairie dogs live in the neighborhood of cultivated ground they are very injurious to green crops. Loring states that in the vicinity of Grand Junction the burrows are usually in the dry banks of irrigating ditches, and the prairie dogs inflict considerable damage on the adjacent truck farms by eating cabbages, cantaloupes, and other crops. While eating, they sit erect on their hind legs, but if disturbed run to the burrows, carrying the food in their mouths. They destroy considerable areas of range grasses and feed extensively in alfalfa fields and hay meadows in the river valleys throughout their range.

Marmota engelhardti Allen. Engelhardt Woodchuck; Marmot.

The Colorado marmots are tentatively referred to this species, which was described from Beaver Mountains, Utah. The scanty material at hand is insufficient for accurate comparison, and definite conclusions are impossible in view of the present condition of the group.

The marmot is one of the most characteristic mammals of the mountains, and occurs from 6,000 feet in the foothills to the rocky summits of the highest peaks, at over 14,000 feet. It has, therefore, a vertical range of about 8,000 feet. Marmots are much more abundant above than below 8,000 feet, and are especially numerous in the slide rock near timberline. They are reported present on the summit of Grays Peak, at an elevation of 14,341 feet, and have been observed also on the summit of Longs Peak, 100 feet lower. The clear, shrill whistle of the marmot is one of the few sounds that break the silence of the high altitudes, and the large reddish-brown animals may often be seen sunning themselves on the warm, flat surfaces of rocks during the middle of the day. In the Hahns Peak region marmots were abundant, and were usually seen around abandoned prospect holes and mining shafts, while at Arkins, Larimer County, one was living in an old sandstone quarry. On the Bear River meadows east of Hayden, Routt County, in August, 1905, I saw a marmot run into its burrow beneath a pile of brush, while a week later four were observed feeding on grass in a meadow along Good Spring Creek, on the north slope of the Danforth Hills. I have found marmots more or less common at Coulter; Mount Whiteley; McIntyre Creek, Medicine Bow Mountains; Elk Head Mountains; Mount Kelso; near Boulder; Sapinero; and Georgetown. They are reported common in the following localities: St. Elmo; Lone Cone; Pagosa Springs; La Plata Mountains, northeast of Mancos; San Juan Mountains, north of Vallecito; Silverton; Cochetopa Pass; Estes Park; and Longs Peak.

In Park County, in 1871, Allen found the marmot abundant from the Platte Valley to above timberline, and states that black specimens occur frequently in that region.[1]

Epimys norvegicus (Erxleben). Norway Rat; Wharf Rat.

There is very little information available on the distribution in Colorado of this noxious species, which is usually known as barn rat or house rat. Doubtless by this time it has reached most of the larger towns at least, as Warren says it is found in Denver, Colorado Springs, Pueblo, and Greeley;[2] and in 1905 I was informed that it was common in the Boulder warehouses. Rats are uncommon away from towns, and I have met very few ranchmen whose buildings are infested with them. Mr. C. H. Smith, of Coventry, Montrose County, reports a very few on his ranch, so they are probably more or less common over the western part of the State, although Warren did not hear of them at Grand Junction. Near Valmont, Boulder County, I caught a large Norway rat in a trap set at a ground squirrel burrow in a prairie dog town, a quarter of a mile from the nearest farm.

Mus musculus Linnæus. House Mouse.

I have not seen the common house mouse in the higher mountains, and have no information regarding its presence above the Transition zone. It is tolerably common in cultivated districts on the plains, in towns, and around farm buildings, and even in fields and meadows, but is not such a pest as in the older settled States. House mice are by no means restricted to the vicinity of railroads, for I have found them in sparsely settled districts 40 or 50 miles from the nearest railroad. At Ashbaugh's ranch, near McElmo, Montezuma County, one was taken in a tule marsh along McElmo Creek, and I have elsewhere observed that marshes are much frequented by this species. A house mouse was killed in one of the buildings at Gaume's ranch, northwestern Baca County, a region where ranches are many miles apart. Another was caught in the barn at the Medano Springs ranch, near the San Luis Lakes. Prof. Lantz found them abundant near Higbee, in southeastern Otero County. White-footed mice of several species take the place of house mice over much of the timbered and canyon country, and in many places are associated with the latter about buildings and sheds.

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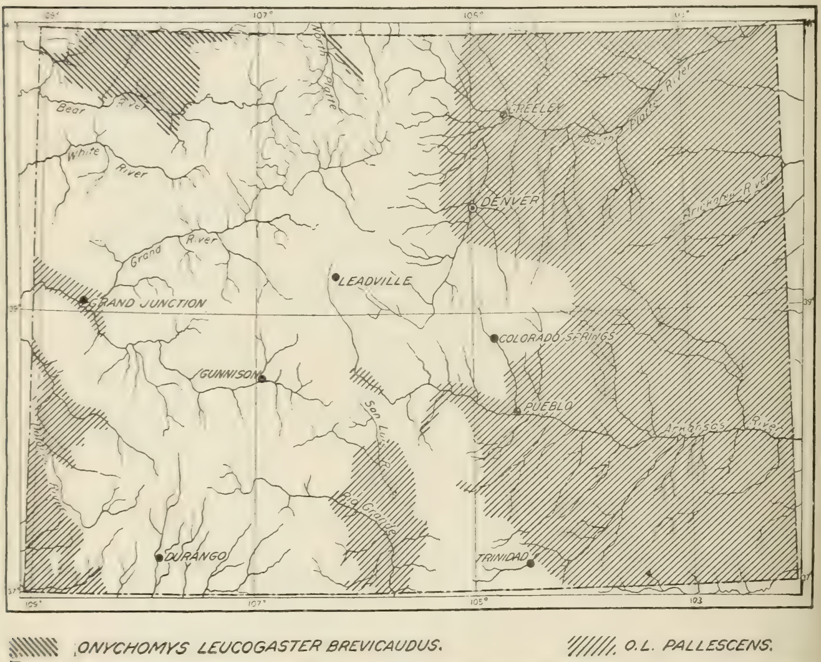
[1] Bull. Essex Inst., VI, p. 57, 1874.

[2] Mammals of Colorado, p. 244, 1906.

Onychomys leucogaster pallescens Merriam. Pale Grasshopper Mouse.

The large pale grasshopper mouse is generally distributed over the Upper Sonoran plains and deserts on both sides of the Continental Divide, except in the northwest corner of the State, where the smaller *O. brevicaudus* replaces it. (See fig. 10.) Specimens from the southwestern desert region and also from the San Luis Valley are larger and paler than those from the northeastern plains, where an approach to *O. leucogaster* is suggested by the darker color.


107°
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North Platte
Bear River
White River
GREELEY
South Platte River
DENVER
Arikaree River
Grand River
LEADVILLE
GRAND JUNCTION
39
COLORADO SPRINGS
GUNNISON
San Luis
PUEBLO
Arkansas River
Rio Grande
DURANGO
TRINIDAD
37
107°
105°
103
ONYCHOMYS LEUCOGASTER BREVICAUDUS.
O.L. PALLESCENS.

FIG. 10.—Distribution in Colorado of grasshopper mice (*Onychomys l. brevicaudus* and *O. l. pallescens*).

This species apparently occupies a considerable area in western Montezuma, Dolores, San Miguel, Montrose, and Mesa Counties, but its range is imperfectly worked out. The distribution in the lower

Grand River Valley appears to be limited, the only specimens thus far taken coming from Fruita, and the Uncompahgre Plateau must certainly separate the Grand Valley range from the more extensive area occupied farther south. The Book Cliffs limit its northward dispersion and separate it from *brevicaudus*. In the San Luis Valley it undoubtedly occurs throughout the Upper Sonoran zone. The grasshopper mice of the Upper Arkansas Valley above the Grand Canyon would appear to be separated from those of the eastern plains by the Royal Gorge, but nothing is known of the distribution in this section aside from the specimens taken on the sandy slopes along the east side of the Arkansas Valley just above Salida. Warren has taken *O. pallescens* in the Wet Mountain Valley. It may have reached this high mountain valley from either the Arkansas Valley on the north or the Huerfano Valley on the south.

Grasshopper mice are nocturnal. They especially frequent sandy areas, and are often taken in traps set at the burrows of kangaroo rats, ground squirrels, and pocket mice. Their carnivorous propensity is one of the chief obstacles the collector meets in trapping the rarer desert mice, and often after nights of trapping without success he is chagrined to find in one of his traps the partly devoured and mangled remains of a rare pocket mouse. Sometimes in regions where grasshopper mice are plentiful, a miscellaneous catch of other species will be almost ruined by them. Much of the food of grasshopper mice consists of soft-bodied insects, such as grasshoppers and crickets. The name scorpion mice, sometimes applied to these rodents, is due to a marked fondness for scorpions, which probably form part of their food in Colorado, particularly in the southwest. Vegetable food also is eaten. At the Medano Springs ranch, near the San Luis Lakes, these mice proved a nuisance by eating carrots, potatoes, and cabbages in a vegetable cellar.

Because of the nature of their food, grasshopper mice decompose much more rapidly than mice which feed chiefly on seeds and vegetable matter.

The pale grasshopper mouse is represented in the Biological Survey collection by a large series of specimens from Loveland, Pawnee Buttes, Sterling, Greeley, Golden, Hugo, Limon, Loco, Canon City, Salida, Burlington, Las Animas, La Junta (18 miles south), Gaume's ranch (Baca County), Antonito, Medano Springs ranch, and Conejos River, in eastern and southern Colorado; and others from Fruita, Coventry, and Naturita, in the southwestern part of the State. I have taken immature specimens at Arkins, in the foothills of Larimer County, and at Ashbaugh's ranch, near McElmo, Montezuma County. A skull in the Merriam collection is from Roggen, Weld County. Specimens from additional localities, Springfield and Monon (Baca County), Moffat, Hooper, San Luis Lakes, Crestone, and Westcliffe, are in the Warren collection.

Onychomys leucogaster brevicaudus Merriam. Idaho Grasshopper Mouse.

This small species apparently does not range south of Bear River, in northwestern Colorado. (See fig. 10.) On the sage plains of North Park it occurs as high as 8,500 feet in the upper part of the Transition zone, but in the region between Snake and Bear Rivers, in western Routt County, it inhabits a much lower altitude. It is usually met with in sandy strips of country, but at no point is it abundant, being always greatly outnumbered by white-footed mice. This species is represented by a series of eight specimens from Canadian Creek, east of Walden, North Park; Snake River, south of Sunny Peak, Routt County; and Bear River, south of Lay.

Allen records a specimen from Three Forks (forks of Snake River), in northeastern Routt County.[1] Warren mentions specimens taken by himself at Craig, and on Snake River 7 miles north of Lily.[2]

Peromyscus leucopus tornillo Mearns. Texas White-footed Mouse.

This form represents *P. leucopus* in the arid region from the Rio Grande at El Paso, Texas, north to the Arkansas Valley. An immature pair collected in the brushy bottom along the Arkansas River at Canon City by Loring, and specimens taken by Warren at Lamar, and in Baca County at Monon, Springfield, and Gaume's ranch, indicate the known distribution of this form within the State. Much work remains to be done in working out the distribution of this and many other small mammals on the eastern plains. Judging from its habits farther south, it should be found in the brushy stream bottoms of most of the region lying south of the Arkansas Valley and east of the foothills, particularly in the piles of drift and rubbish left after freshets. Regarding its habits in Baca County, Warren says: "The specimens taken in Baca County were mostly found among the sandstone bluffs along the water courses, although a few were taken about some ranch buildings." [3]

Peromyscus maniculatus nebrascensis (Mearns). Nebraska White-footed Mouse.

This is the common white-footed mouse of the Upper Sonoran plains region of both eastern and northwestern Colorado, as shown by series of specimens from a great many localities. It is found also in the sandy strip of country along the eastern side of San Luis Valley. Along the edge of the foothills and the higher western plateaus it grades into the dark reddish *P. rufinus* of the mountains. Like that form, it inhabits all conceivable situations, but it is normally more abundant, and sometimes becomes exceedingly numerous despite coyotes, hawks, and owls. Such was the case on the sage plains of western Routt and Rio Blanco Counties in 1906; also at the Medano Springs ranch, in the San Luis Valley, in October, 1907, where in a single night 38 were caught in 1 acre by 60 traps, and their excessive numbers all but prevented my securing topotypes of *Reithrodontomys montanus*. On several occasions two were taken in a small trap at one setting. In the Green River Valley near Ladore white-footed mice were often seen in the dusk darting about the bases of cottonwood trees. They were everywhere a great nuisance, gnawing harness, foraging in our provisions, and, above all, depleting our much-needed supply of oats. In the rocky juniper and pinyon country of western Colorado this race is found over considerable areas with two other forms of white-footed mice, *P. truei* and *auripectus*, but everywhere outnumbers them.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 253, 1896.

[2] Further Notes on the Mammals of Colorado, p. 72, 1908.

[3] Mammals of Colorado, p. 245, 1906.

Peromyscus maniculatus luteus Osgood. Yellow White-footed Mouse.

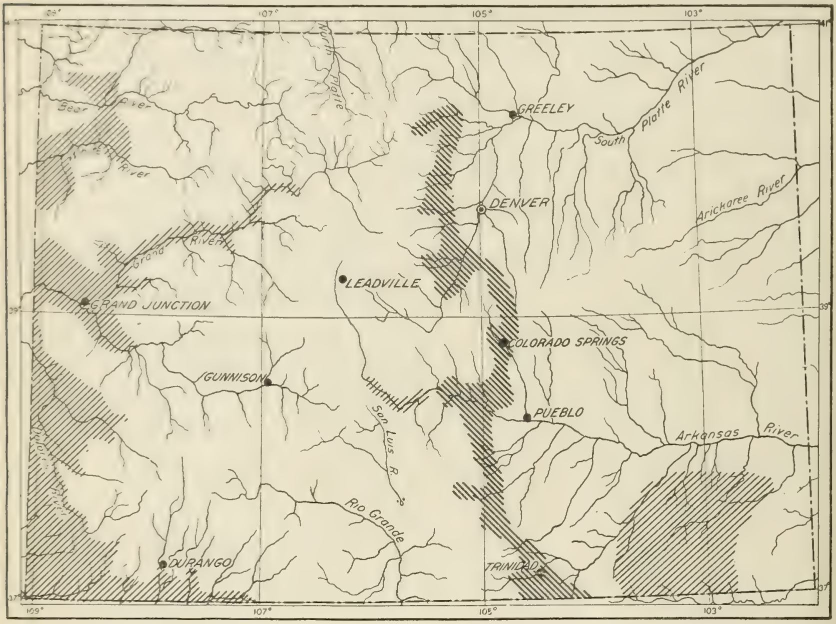
Five specimens in the collection of the Colorado Agricultural College have been identified by W. H. Osgood as *P. m. luteus*. They were collected in Spring Canyon, 4 miles southwest of Fort Collins. Others taken by Warren at Wray, Yuma County, seem referable to this beautiful yellowish species. There are specimens from Haigler, Nebraska, just east of the Colorado line, in the Biological Survey collection. Future collecting will doubtless show that *luteus* is present over much of the sandy area of the northeastern counties.

Peromyscus maniculatus rufinus (Merriam). Tawny White-footed Mouse.

The wide range of this form in the Colorado mountains is shown by a large series of specimens. The center of abundance is in the boreal zones on the main ranges. In the foothills east of the front ranges, and on the slopes of the plateaus in northwestern Colorado, it shades off almost imperceptibly into the pale form *nebrascensis* of the Upper Sonoran plains and valleys. Specimens from Estes Park, Boulder, Gold Hill, and Nederland show a decided approach to *P. nebrascensis*. *P. m. rufinus* is almost omnipresent in the mountains and lives indiscriminately under logs and brush piles in the heavy forests, among rocks, in cabins along streams, in mountain bogs, and among the sagebrush in mountain parks. In the southwest it occurs at lower elevations and inhabits semidesert areas. In the sand hills at the west base of the Medicine Bow Range, in North Park, this mouse was abundant among the *Chrysothamnus* bushes.

These mice were very numerous in the sandy flats along the eastern side of the Arkansas Valley just north of Salida, in November, 1907. Nearly all trapped at this point were in soiled pelage, the dorsal fur being of a dark olive-greenish cast, while the underparts were heavily tinged with dirty plumbeous. Mr. J. W. Frey, of Salida, accounts for this soiling by the statement that the prevailing westerly winds carry the smoke of the Salida smelter to the east side of the valley, where much of the time it hangs in a dense pall, soiling the vegetation and, indirectly, the mice which come in contact with it. Kangaroo rats living on the same sand flats were somewhat smoke-soiled, but not to the same extent.

P. m. rufinus appears to be as strictly nocturnal as the other deermice. In the little cabin on the edge of the cliffs just above the Spruce Tree Cliff Ruins, at the head of Navajo Canyon, on the Mesa Verde, I heard these mice squeaking about midnight of June 13. A faint squeak in one end of the cabin elicited answers from other parts of the building, and the noise was kept up for some time.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Grand River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD

▨ PEROMYSCUS TRUEI. ▨ P. NASUTUS.

FIG. 11.—Distribution in Colorado of cliff mice (*Peromyscus truei* and *P. nasutus*).

Peromyscus truei (Shufeldt). True Cliff Mouse.

This large-eared species has a wide distribution in the warmer parts of western Colorado, where in common with many other Upper Sonoran mammals its range is practically coextensive with the juniper and pinyon belt. (See fig. 11.) It has been taken also in the juniper country of the southeastern corner of the State, and Warren has it from Salida and Parkdale, in the upper Arkansas Valley. Over much of its range in northwestern Colorado this species and the smaller-eared *nebrascensis* occur together, and in the southwest it is usually associated with *P. auripectus* and *rowleyi*.

The True cliff mouse almost always lives in the cliffs and rocky ledges along canyons or in hollow junipers and pinyons. In the dense juniper growth at the northern base of the Escalante Hills it was very abundant and was taken in traps placed in and around hollow junipers.

In the Grand River Valley it ranges east to McCoy, Eagle County. Although taken in Montezuma County, both on the Mesa Verde and in the McElmo Canyon, it does not appear to be so common there as *auripectus*. At Coventry it was abundant in rocky ledges among the pinyons and along the cliffs bordering Naturita Creek, where it was associated with both *rowleyi* and *auripectus*. Most of those taken at this point in July, 1907, were from half to two-thirds grown.

I found *P. truei* common in the rocky canyons and juniper country near Gaume's ranch in northwestern Baca County, and also collected a specimen in the rocky ledges at Rhinehart's Stage Station, on the plains of southern Prowers County, 20 miles south of Lamar. Prof. Lantz has taken it in southeastern Otero County, 18 miles south of La Junta.

Although this species almost invariably inhabits the Upper Sonoran zone, I have taken it once in the aspen forest in the Canadian zone. This was at the Club ranch, near Uncompahgre Butte, at the extreme head of Mesa Creek, at nearly 9,000 feet. An adult female was caught in a trap set beneath a log lying in a boggy aspen thicket July 17, 1907. There was none of the normal environment of *truei*—rocky pinyon or juniper slopes—within a mile or within a vertical distance of fully 1,500 feet, and this individual must have reached this high elevation from the lower country by following up one of the numerous canyons heading on the upper western slopes of the Uncompahgre Plateau.

In September, 1906, a favorable opportunity was afforded for observing these interesting mice on White River a few miles west of Rangely. My tent was pitched in a dense *Lepargyrea* thicket, and a sack of oats proved a great attraction to white-footed mice. All night long they were darting noisily over the tarpaulin, climbing the tent walls, and investigating the provisions. In the early morning numbers of both *P. truei* and *nebrascensis* were seen running about, all intent upon transferring a winter's supply of oats from the sack to their nests in the thicket. I observed that one of the large-eared mice, meeting an individual of the other species, invariably retreated precipitately, and gained the oat sack only by the exercise of great caution. The True cliff mouse presents a most peculiar and striking appearance in life with its large protruding eyes and immense ears. It is remarkably agile and takes long leaps with the greatest ease.

Peromyscus nasutus (Allen). Estes Park Cliff Mouse.

Vesperimus nasutus Allen, Bull. Am. Mus. Nat. Hist., III, p. 299, 1891. Type from Estes Park, Larimer County, Colorado.

This large plumbeous species has been taken at a number of localities in the eastern foothills of Colorado, but its range has not been satisfactorily worked out. (See fig. 11.) While it has been found as high as 8,400 feet, its center of abundance appears to be in rocky situations along the lowest edge of the foothills. It has not been taken in Wyoming, but is common in many places in the foothills of the New Mexico mountains. It belongs to the large-eared group of white-footed mice and bears a close resemblance to *P. truei*. It may be distinguished from the latter species, however, by its somewhat smaller ears and grayer or more plumbeous coloration, while the skull is a little larger and has longer nasals and much smaller audital bullæ.

At Estes Park (the type locality), Edward A. Preble secured specimens in a rocky gulch near the summit of a hill bordering the park, at 8,400 feet. Dr. Fisher found the species common in crevices in the rocky rims of the table mountains near Trinidad. Other members of the Biological Survey have taken it at Boulder, Gold Hill, and Canon City. Warren reports it as common in the vicinity of Colorado Springs, "both in the foothills and in the bluffs to the north and east of the city."[1]

Peromyscus boylei rowleyi (Allen). Rowley Cliff Mouse.

Specimens of this large long-tailed species from Arboles, Mesa Verde, and Coventry in the Biological Survey collection, and others from Cortez, Salida, and Irwin's ranch (Las Animas County), identified for Warren, represent all the information available on its distribution within the State. Noland's ranch, Utah (the type locality), is situated on the San Juan River within a few miles of the Colorado line. The Rowley cliff mouse is an Upper Sonoran species inhabiting rock ledges and cliffs in the juniper belt and probably occurs over most of the lower country in southwestern Colorado. It probably reaches Salida, in the upper Arkansas Valley, from the south and east, since Warren found it in the juniper country of northeastern Las Animas County. There are no specimens from the San Luis Valley, and hence it seems unlikely that it has reached the upper Arkansas region over the Poncha Pass.

At Coventry, Montrose County, where a small series representing both sexes was collected in July, 1907, I found *P. rowleyi* and *P. truei* about equally abundant in some low rocky ledges in a dense growth of pinyons. A long line of traps placed along the high and nearly naked cliffs bordering Naturita Creek yielded fewer specimens of *rowleyi* and more of *truei*. Most of the cliff mice taken at this season were half or two-thirds grown. Near the Spruce Tree Cliff Ruins, on Mesa Verde, at an elevation of 7,000 feet, an adult male *rowleyi* was trapped in a *Microtus* runway among the fallen leaves in an oak thicket. Tracks of a large cliff mouse were abundant in the fine chalk-like dust among all the cliff ruins examined on the Mesa Verde, but, as I had no time for careful trapping, it was impossible to determine which of the two species, *truei* or *rowleyi*, was more abundant. The Rowley cliff mouse was not taken at Ashbaugh's ranch, in the lower McElmo Canyon, but is doubtless present there, since Warren has two specimens from Cortez, near the head of McElmo Canyon. Arboles appears to be near the eastern limit of dispersion in the valley of the San Juan. Traps placed among the dry rock ledges on the north side of the San Juan at this point, June 7, 1907, yielded two immature specimens and one adult.

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[1] Mammals of Colorado, p. 247, 1906.

Peromyscus crinitus auripectus (Allen). Golden-breasted Canyon Mouse.

The type locality of this beautiful mouse is Bluff City, Utah, on the San Juan River, 40 miles west of the Colorado line. It inhabits the rock ledges and cliffs in much of the rough canyon and mesa country of western and southwestern Colorado, in the Upper Sonoran zone, becoming increasingly numerous toward the extreme southwest. It ranges northeast in the Grand River Valley to the Grand Canyon, east of Glenwood Springs, but was not found on the lower White River or at any point north of the Book Cliffs, and this high escarpment doubtless forms the northern boundary of its habitat. This mouse is usually associated with *P. truei*, but does not range so high. It appears to be restricted to the warmest valleys below 6,500 feet.

I first met with the golden-breasted mouse in the canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County, where a female was trapped among the rocky ledges. It was again found at three widely separated localities in Montezuma and Montrose Counties. A specimen was secured among the Spruce Tree Cliff Ruins on Mesa Verde, and five specimens, representing both sexes, were collected in the rock ledges and cliffs bordering McElmo Creek at Ashbaugh's ranch, 20 miles west of Cortez. At Coventry, Montrose County, *P. auripectus* is greatly exceeded in numbers by both *truei* and *rowleyi*. I trapped a single specimen at this point in the rocky cliffs north of Naturita Creek. Mr. C. H. Smith, of Coventry, has collected a number of the golden-breasted mice among the same cliffs and does not consider them at all rare. Warren has this species from Grand Junction. Thus far it has not been found at any point in the Gunnison Valley, but this is doubtless owing to lack of careful collecting in that region.

Reithrodontomys montanus (Baird). Mountain Harvest Mouse.

> *Reithrodon montanus* Baird, Proc. Acad. Nat. Sci. Phila., p. 335, 1855. "Vicinity of the Rocky Mountains, lat. 38°." Type locality restricted by Allen (Bull. Am. Mus. Nat. Hist., VII, p. 125, 1895) to "upper part of the San Luis Valley."

The type specimen of this interesting little harvest mouse in the National Museum was collected by F. Kreuzfeldt on Capt. E. G. Beckwith's expedition to the Pacific coast in August, 1853, and until recently remained unique. The exact locality is indeterminate, but from the itinerary appears to have been on the east side of the San Luis Valley about one-third the distance between old Fort Massachusetts (near Fort Garland) and Cochetopa Pass—probably not far from the San Luis Lakes.

Vernon Bailey collected a harvest mouse at Del Norte in September, 1903, but it was so immature as to throw little additional light on the status of Baird's *montanus*. The Del Norte specimen was trapped "under a bunch of *Sarcobatus* at the edge of an alfalfa field."

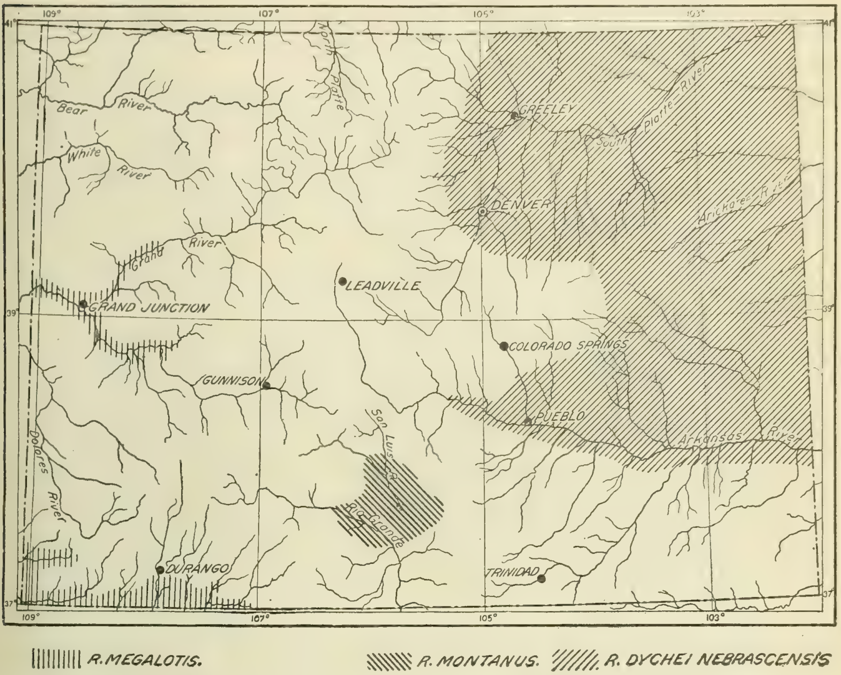
Considerable areas of swamp land and wet meadows in various parts of the San Luis Valley furnish an ideal environment for harvest mice. When in the region, in October, 1907, in quest of specimens of *montanus*, I visited the Medano Springs ranch, 15 miles northeast of Mosca and a short distance northeast of the San Luis Lakes, as this seemed very near where the type specimen must have been taken. Here the extensive hay meadows and marshes along Medano Creek appeared well suited to harvest mice; but after trapping carefully for a week in wet situations without success and taking meanwhile one adult and three young in the rank grass beneath *Sarcobatus* bushes on higher ground, I decided that *montanus* must be sought in dry situations. Accordingly, during the first week in November, all the traps were placed in a grassy weed patch on a broad sand ridge extending through the meadows and perhaps 6 feet above their level. Most of the specimens collected at this time were caught in traps placed in the dense growth of grass beneath the bushes of rabbit brush (*Chrysothamnus patens*), which occupied one end of the sand ridge. A very few were taken among the scattering dry stalks of *Peritoma sonoræ*. The series of 13 males and 7 females collected contains only 4 or 5 adults. Doubtless many more of this species would have been taken had the majority of the traps not been filled each night with voles and white-footed mice, which were exceedingly numerous in both wet and dry situations.

This is probably an isolated intermountain species. Its known range is indicated by Del Norte, Medano ranch, and Crestone, Warren having taken it at the last-named place in early October, 1909. (See fig. 12.)

A. H. Howell, of the Biological Survey, who has in preparation a revision of the genus *Reithrodontomys*, has compared with related forms the topotype series of *R. montanus* from Medano Springs ranch. The following characterization is from his manuscript:

"*General characters.*—Size small (about the size of *humilis*); ears and tail short; colors pale.

"*Color.*—(Fresh winter pelage, October and November). Pinkish buff, clearest on sides and face, much mixed with blackish on dorsal surface. Black hairs, most pronounced on hinder back. Ears much as in *megalotis*, usually clothed on inner surface with ochraceous buff hairs (a little darker than body hairs), sometimes, though not always, with a distinct blackish area on lower margin. Tail distinctly bicolor—grayish brown above, white beneath. Compared with *megalotis*, the general tone is paler and less brownish; dorsal area more distinct from color of sides; sides pinkish buff instead of ochraceous buff; tail grayer (less brownish).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GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
San Luis R.
Rio Grande
PUEBLO
Arkansas River
Dolores River
DURANGO
TRINIDAD
||||||| R. MEGALOTIS.
\\\\\ R. MONTANUS.
///// R. DYCHEI NEBRASCENSIS

FIG. 12.—Distribution in Colorado of harvest mice (*Reithrodontomys*) except *R. albescens*.

"*Cranial characters.*—Skull about the same size as that of *humilis*, but with narrower rostrum and interorbital region; zygomata narrowing anteriorly; nasals longer; molars heavier. Compared with *megalotis* the resemblance is very close; *montanus* averages smaller, with narrower and relatively higher brain case.

"*Measurements.*—Average of 10 specimens from Medano Springs ranch: Total length, 126 (118–139); tail vertebræ, 58 (51–64);

hind foot, 17 (16–17.5). Average of three skulls: Occipito-nasal length, 20.2; breadth of brain case, 9.4; length of nasals, 7.9."

R. montanus is a small, short-tailed species related to *R. albescens* and *R. griseus*, and, like these, frequents dry grassy situations. Compared with *R. megalotis*, it may be distinguished by its smaller size, paler coloration, and shorter ears and tail. From the pale grayish form *albescens* of the Nebraska sand hills, *montanus* differs in darker (less gray) coloration, and somewhat larger ears, while the skull is relatively longer and narrower and the rostrum longer than in *albescens*.

Reithrodontomys montanus albescens Cary. Pallid Harvest Mouse.

Four specimens of harvest mice from Loveland in the Miller collection seem referable to *R. m. albescens*, although somewhat intermediate in characters between *albescens* and *griseus*. The relative abundance and distribution of harvest mice on the plains of eastern and northeastern Colorado will not be known until more thorough collecting is done. Possibly *albescens* or some other form of the short-tailed group occurs with *R. nebrascensis* over much of the plains region, as in western Kansas and Nebraska.

Reithrodontomys dychei nebrascensis Allen. Nebraska Harvest Mouse.

The Nebraska harvest mouse doubtless occurs over most of the plains region east of the foothills in the northern two-thirds of the State. (See fig. 12.) There are specimens from Denver, Golden, Valmont, Boulder (5 miles west), Loveland, Greeley, and Canon City, but none have been taken on the plains south of the Arkansas Divide. The species is usually taken in wet meadows, in alfalfa fields, or along the grassy margins of irrigation ditches, but may be found also in smaller numbers on dry uplands where there is a sufficiently heavy growth of grass and weeds. Harvest mice range a short distance into the foothills, along some of the streams, following the widest and warmest valleys. I trapped one specimen at Blanchard's ranch, on Middle Boulder Creek, 5 miles west of Boulder. It was taken in a grassy swale along the stream at 5,600 feet, in the Transition zone. At Wray one was seen in a tangle of willow brush in the boggy bed of a canyon, where in moving about in the brush it often wrapped its tail around a twig by way of assistance.

Reithrodontomys megalotis (Baird). Big-eared Harvest Mouse.

This large-eared desert harvest mouse ranges into the State from the west and southwest, following the low Upper Sonoran valleys. It is not known to occur north of the Grand River Valley. (See fig. 12.)

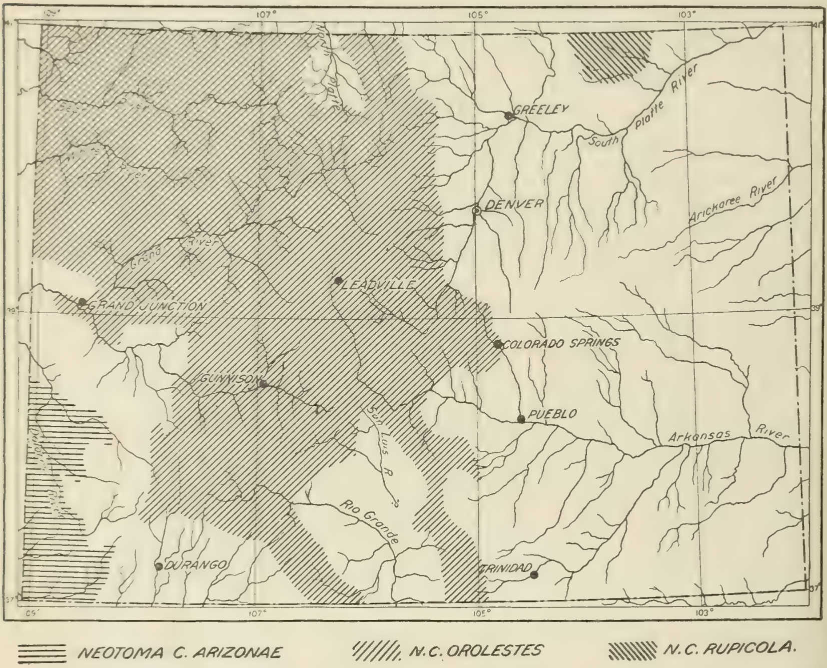
At Arboles, in southwestern Archuleta County, near the New Mexico boundary, a female was taken in a trap set in the short grass beneath a dense growth of willows and buffalo berry (*Lepargyrea argentea*) on the bank of the San Juan River. Two males taken from six traps set in a tule marsh along McElmo Creek at Ashbaugh's ranch, Montezuma County, during the night of June 19, 1907, indicate that harvest mice are tolerably common in that locality. I collected one at Hotchkiss August 9, beneath a low rocky ledge bordering a small tule marsh along the North Gunnison River. This specimen was nearly eaten up by other mice, but the skin of back and rump which I preserved is grayish and does not at all resemble the usual fulvous summer pelage of *megalotis*. This species is not by any means restricted to marshes and damp situations, as was shown by two specimens trapped among beds of *Opuntia* on a high sand knoll in the Grand Valley near Morris, 7 miles west of Rifle, August 13 and 14. These specimens, a male and a female, are gray, like the Hotchkiss example. The female contained six fetuses. A series of 25 specimens taken by Howell at Grand Junction early in November, 1895, are in early winter pelage; while another individual which Preble secured at the same locality August 25, 1895, is in the bright fulvous summer coat. Warren has a specimen from Cortez, Montezuma County.

Neotoma cinerea orolestes Merriam. Colorado Bushy-tailed Wood Rat.

Neotoma orolestes Merriam, Proc Biol. Soc. Wash., IX, p. 128, July 2, 1894. Type from Saguache Valley (20 miles west of Saguache), Colorado.

Bushy-tailed wood rats are common throughout the mountains and also in the rough juniper and pinyon country of western Routt and Rio Blanco Counties. On the eastern slopes of the main ranges they rarely occur below 6,000 feet, and are largely replaced in the lower foothills by the smaller round-tailed *N. fallax*. They have been found from an elevation of only 4,500 feet at Grand Junction to timberline on Mount McClellan and near Silverton, thus having a vertical range of approximately 6,000 feet. (See fig. 13.) Specimens from the lower arid western portions of Routt and Rio Blanco Counties are usually much paler than those from the main mountain ranges.

In 1905 and 1906 I observed *N. orolestes* in all the mountainous country traversed. It was least common in the Middle and North Park region, where a few stick nests were noted in the cliffs along Grand River and in the Rabbit Ear Mountains, and one rat was seen in an old cabin near Fraser. In the rough country bordering the lower Snake and Bear Rivers the favorite homes of this species are in hollow junipers, which are often completely filled with sticks, cactus pads, bones, and other nest material. In this region the rats live also among the rocky bluffs, in hollow cottonwoods along the streams, in the adobe banks of arroyos, and occasionally in thickets of buffalo berry. One nest noted on Snake River was in a buffalo berry bush fully 10 feet above the ground. The few old cabins which I entered in the Snake River Valley below Baggs Crossing were inhabited by numbers of rats, in addition to two or three species of bats and innumerable white-footed mice. The cupboard, stoves, shelves, and bunks were filled with trash carried in by the rats, and an immense pile of rubbish had been piled up in a corner of one of the cabins. I often saw wood rats running about in the cabins during the daytime, and on Bear River shot one among the rocks at midday. At one of our Snake River camps wood rats were very abundant and all night long could be heard climbing the tent walls, investigating our supplies, and running back and forth across our blankets. One was bold enough to nip my companion's ear.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GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
DURANGO
TRINIDAD
NEOTOMA C. ARIZONAE
N.C. OROLESTES
N.C. RUPICOLA.

FIG. 13.—Distribution in Colorado of bushy-tailed wood rats (*Neotoma c. arizonæ*, *N. c. orolestes*, and *N. c. rupicola*).

Supposed nests of *N. orolestes* were seen at Sapinero, Somerset, and on the Uncompahgre Plateau in 1907, and the species was reported at St. Elmo, in northwestern Huerfano County, and at many other localities. Bailey reports it common in the canyon of Conejos River, west of Antonito. It is represented in the Biological Survey collection by specimens from a wide range of localities in the Colorado mountains.

In its propensity for carrying rubbish into deserted cabins this species resembles other members of the genus, and it also shares with them the habit of hiding in its nest all manner of portable articles which attract its fancy. The industry of these rats is remarkable, and a pair can accomplish a surprising amount of work in one night. On the lower Snake River a stick nest of considerable size was built near the oat sack in our camp wagon while we slept, and a wood rat was found early the next morning domiciled therein.

The nests are found in a variety of situations. In the mountains they are usually placed in cracks and crevices of rocky ledges and cliffs or in deserted cabins. Miners at the Stevens Mill, at timberline on Mount McClellan, reported a few rats living in the mine several hundred feet from the entrance, and stated that the animals often passed them on the ladders.

Neotoma cinerea arizonæ Merriam. Arizona Bushy-tailed Wood Rat.

Bushy-tailed wood rats from Ashbaugh's ranch (near McElmo), Montezuma County, and from Coventry, Montrose County, are referable to this small southwestern species. Warren has taken it at Cortez, Montezuma County, and at Bedrock, Montrose County, and it appears to be the species so common among the cliff ruins on Mesa Verde. It is mainly Upper Sonoran in distribution, and probably does not occur north of the San Miguel Valley (see fig. 13), since *N. orolestes* is the species found in the Grand Valley at Grand Junction. Intergradation between *arizonæ* and *orolestes* probably takes place in the region of the Uncompahgre Plateau, but there are no specimens to decide this point.

The Arizona wood rat is uncommon at Coventry, being greatly outnumbered by the little gray round-tailed *N. fallax* in the cliffs along Naturita Creek. In the cliffs at Ashbaugh's ranch, also, I found both species occurring together, but here the bushy-tailed rats were more numerous. The nests of the two are apparently indistinguishable, and both species were taken in traps set at the same nest. One of the yellowish bushy-tailed rats was seen running along a rocky ledge about 4 o'clock one afternoon. Its course led from one sheltering rock to another and obliged it to cross short intervening spaces of sunlight. The rat took advantage of all the shadows and dark recesses, and when forced to cross a bright open space its movements were so quick that the eye could scarcely follow. Other rats were dimly seen moving about in nests far back under rocks.

Many wood rat tracks which I saw in the fine dust of the Spruce Tree Cliff Ruins (see Pl. IV, fig. 1) on Mesa Verde, as well as fresh stick nests found in the neighboring rock ledges, indicated an abundance of the animals at this point—doubtless both *fallax* and *arizonæ* being present. Large piles of well-preserved rat excrement found in many of the rooms among the ruins were apparently as old as the ruins themselves, being blackened with the same smoke which begrimed the interior of the rooms and caverns centuries ago.

Neotoma cinerea rupicola Allen. Pallid Bushy-tailed Wood Rat.

Eight specimens from Pawnee Buttes and the Chimney Cliffs (30 miles northwest of Sterling) agree closely with topotypes of *N. rupicola* from Corral Draw, Big Bad Lands, South Dakota. This interesting series greatly extends the known range of the species and gives the first record for Colorado. (See fig. 13.)

Near the Chimney Cliffs two nursing females, an adult male in badly worn pelage, and two young about quarter grown, were collected June 4 to 8, 1909, on the talus slopes and rocky buttes in the open valley a mile or so south of the cliffs. The rats probably inhabit all the buttes scattered here and there over the upper drainage of Horsetail Creek east to within 15 miles of Sterling. They appear to be uncommon, however, among the precipitous white badland cliffs which form the northern boundary of the Horsetail Valley. This may be because there are fewer natural crevices and recesses for nesting sites in the soft white rock of the badland formation. Rat nests were numerous beneath the bowlders and rock ledges on the buttes in the valley, as they were also in similar situations at Pawnee Buttes, some 25 or 30 miles southwest. The species appeared inactive at both localities, however, and I found it difficult to secure specimens. The two nursing females from the Chimney Cliffs are in fresh light yellowish summer pelage, while all the males taken are in worn and faded whitish winter pelage.

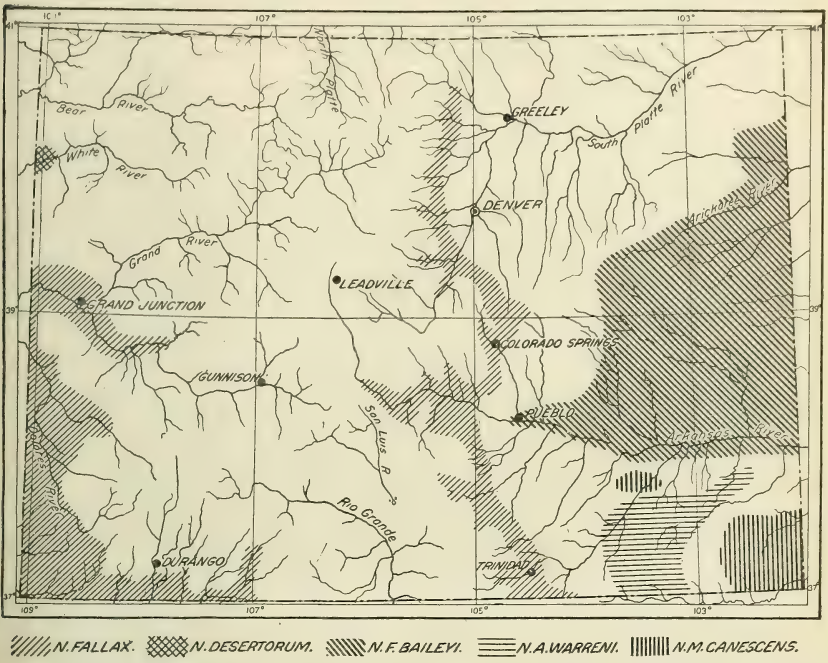
N. rupicola is the palest known member of the genus. It is a small form of the bushy-tailed group, inhabiting the rough areas of badland bluffs and buttes from western South Dakota south to northeastern Colorado, in the Upper Sonoran zone. I secured it in the bluffs along Laramie River at Uva, Wyoming, and it occurs also in the rocky bluff region of extreme western Nebraska.

Neotoma floridana baileyi Merriam. Bailey Wood Rat.

This is the only representative of the *Neotoma floridana* group in Colorado. It enters the State from the east, in the valleys of the Republican and Arkansas Rivers and tributary streams, and ranges westward along the Arkansas to Pueblo and farther north to Flagler and Wray. (See fig. 14.) It is restricted to the Upper Sonoran zone.

At Olney, in December, 1894, Mr. C. P. Streator found this wood rat abundant in thickets of tree cactus (*Opuntia arborescens*) and collected a series of 12 specimens. He was informed by stockmen that a few are found 10 miles north of Arlington, Kiowa County, and also along the Arkansas River south of Chivington. Concerning the distribution of *N. baileyi* in the Arkansas Valley, Mr. Streator reports that it "evidently occurs wherever there are rocks, tree cactus, or hollow trees." He found it common also in the cliffs bordering the valley of the South Fork of the Republican River near

Flagler. It is abundant in the sandstone ledges bordering the South Fork Valley in the vicinity of Tuttle, where I captured specimens, and found the nests composed of sticks, dried cow manure, bones, and rubbish of all sorts, with cactus and yucca spines for protection. Prof. D. E. Lantz reports pack rats common in hollow cottonwoods along the Big Sandy near Hugo, and I found old nests among the rocks on the northern face of Cedar Point, northwest of Limon. This should be the form represented at both the above localities. At Wray, where I secured specimens, this rat was inhabiting sandstone ledges along the valley, much as at Tuttle. There is a specimen from Pueblo, and the rats are reported by Mr. H. W. Nash as common at that point.[1] The American Museum of Natural History has a specimen from Fort Lyon, on the Arkansas River, collected by Capt. P. M. Thorne February 4, 1885. This specimen has been recorded as *N. campestris*.[2]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Bear River
White River
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Platte
GREELEY
South Platte River
Arickaree River
DENVER
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
San Luis R
Rio Grande
Arkansas River
Dolores River
DURANGO
TRINIDAD
N.FALLAX.
N.DESERTORUM.
N.F.BAILEYI.
N.A.WARRENI.
N.M.CANESCENS.

FIG. 14.—Distribution in Colorado of round-tailed wood rats (*Neotoma fallax, N. desertorum, N. f. baileyi, N. a. warreni,* and *N. m. canescens*).

Neotoma f. baileyi is a large, long-tailed, gray form of the round-tailed group, and quite unlike any of the other Colorado species.

Neotoma micropus canescens Allen. Hoary Wood Rat.

The hoary wood rat has been found only in the southeast corner of the State, in southeastern Otero County and in Baca County, this being the northern known limit. (See fig. 14.) A specimen taken by Warren at Monon, and sent to the Biological Survey for identification, proves referable to this form. Mr. Warren found this wood rat also at Springfield, and states that he found it living chiefly among rocks, but that some were living in the buildings of an unoccupied ranch. Near Higbee, Otero County, where Prof. Lantz secured a specimen in April, 1910, these rats were living among rocks and in hollow junipers on the mesas and in clumps of tree cactus (*Opuntia arborescens*) in the open Purgatory Valley. On the deserts of western Texas and over the greater part of its range the species lives in open country, the nests being usually in bunches of cactus or other spiny shrubbery.

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[1] Mammals of Colorado, p. 247, 1906.

[2] Allen, Bull. Am. Mus. Nat. Hist., VI, p. 322, 1894.

Neotoma albigula warreni Merriam. Warren Wood Rat.

Neotoma albigula warreni Merriam, Proc. Biol. Soc. Wash., XXI, pp. 143–144, June 9, 1908. Type from Gaume's ranch, northwest corner of Baca County, Colorado.

This medium-sized wood rat closely resembles *N. m. canescens* in its gray coloration, but its relationships are with *albigula*. It inhabits the rough juniper country of southeastern Colorado, and also occurs in northeastern New Mexico, where it doubtless grades into *N. albigula*. It is abundant in Shell Rock Canyon, in extreme northwestern Baca County, and Warren found it at Irwin's ranch, in eastern Las Animas County. It may be the species inhabiting the rock ledges at Rhinehart's stage station, 20 miles south of Lamar, in southern Prowers County, but no specimens were taken at that point. Doubtless it occurs throughout the juniper country of western Baca and eastern Las Animas Counties. (See fig. 14.)

At Gaume's ranch, in Shell Rock Canyon, I found these wood rats living among rocks along the canyon walls or in hollow junipers on the upper rims of canyons, and occasionally in large stick houses reared against the bases of junipers in the dense growth well back from the canyon rims. Whether among the rocks or in the junipers, the nests were fortified with a varied assortment of spines and thorns, the sharp spiny bundles of the tree cactus (*Opuntia arborescens*) always predominating. The stick houses averaged about 2 feet in height and often contained several bushels of dead juniper branches. Judging from the signs observed at the nest entrances, the rats were subsisting largely at this time of year (November) upon the berries of *Juniperus monosperma.*

According to Mr. E. J. Gaume, these rats seldom take up their abode in abandoned houses as do the "short-tailed blue rats" (undoubtedly referring to *N. m. canescens*) of eastern Baca County. Regarding the habits of this species at Gaume's ranch, Warren says: "It did not seem to breed as early as *N. micropus* [*N. m. canescens*] at Monon, for half-grown young of the latter species were taken the 1st of May, while the present species was apparently just beginning to breed after the middle of the same month."[1]

Neotoma fallax Merriam. Gale Wood Rat.

Neotoma fallax Merriam, Proc. Biol. Soc. Wash., IX, p. 123, July 2, 1894. Type from near Gold Hill, Boulder County, Colorado.

The type specimen of this small gray round-tailed wood rat was taken by the late Mr. Denis Gale on a tributary of Boulder Creek, near Gold Hill, at the extreme upper limit of the range of the animal. Other specimens in the Biological Survey collection are from the following localities, chiefly in the lower eastern foothills: Boulder; Arkins; Loveland; Canon City; Trinidad; Fisher Peak; Martinsen, Las Animas County; Arboles; near McElmo; and Coventry. Specimens from Colorado Springs, Spring Canyon (near Fort Collins), and Grand Junction have been sent to the Biological Survey for identification. Other localities from which Warren has specimens are Cortez, Salida, Van Andert's Spring (on Little Fountain Creek, southwest of Colorado Springs), and Howard.

N. fallax is common among the eastern foothills north across the State as far as Fort Collins. It occurs from the lowest outlying talus slopes at the edge of the plains to an altitude of about 7,500 feet, mainly in the Transition zone. (See fig. 14.) In the Canadian zone it is replaced by the larger bushy-tailed *N. orolestes*. The two species occur together at a number of localities (including the type locality of *N. fallax*) between 6,000 and 7,000 feet; and at Blanchard's ranch, 5 miles west of Boulder, both have been taken at 5,800 feet. Throughout this region of vertical overlapping of ranges (about 2,000 feet), however, *fallax* is the commoner species. Warren has taken both species at Grand Junction, below 5,000 feet.

From Trinidad this species probably extends south in the Upper Sonoran and Transition zones around the southern ends of the Culebra and San Juan Ranges, thus reaching southwestern Colorado from the south, rather than from the east through the lowest mountain passes. At Pagosa Springs, Arboles, and Bayfield it inhabits rock ledges—at Pagosa Springs in gulches in the yellow-pine forest and at the last two localities down among the pinyons. It is also common with *N. arizonæ* in the cliffs along McElmo Creek at Ashbaugh's ranch, Montezuma County, and on Naturita Creek at Coventry, at the last locality being occasionally found about ranch buildings. This seems to be the species commonly known in the lower parts of western Mesa, Montrose, and San Miguel Counties as the sleek-tailed rat. Fresh nests were found beneath the rocky ledges on Dry Creek, west of Naturita, and others in the Sinbad Valley, near Uranium. A very few nests seen in the bluffs along the North Gunnison River near Hotchkiss appeared to belong to *fallax* rather than to *orolestes* It is not known from the San Luis Valley, but careful collecting on the lower slopes of the bordering mountains may prove its presence in that region.

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[1] Mammals of Colorado, p. 248, 1906.

In its habits *fallax* does not differ materially from the other wood rats. It is equally at home in deserted mines, prospect holes, cabins, and among rocks; while a talus slope seems peculiarly attractive to it. The type specimen was taken in a stamp mill. Near Canon City Bailey found several nests in hollow junipers, and in southwestern Colorado I have often seen nests in junipers and in pinyons. The piles of sticks, stones, and other trash accumulated by these rats among the rocks and on talus slopes are not so large as in old cabins. The stove in a cabin which I entered near Gold Hill was completely filled with sticks and rubbish, while the nest in the oven was composed of softer materials. Among the varied assortment of nest materials used by this wood rat may be mentioned juniper branches, sticks, stones, bones, dried horse dung, pads of prickly pear cactus (*Opuntia*), and the branches of a variety of thorny and spiny plants, such as roses, haws (*Cratægus*), *Ceanothus fendleri*, and yuccas. The inner nest is often composed of the soft inner bark of the juniper. At Walsenburg and Badito, in Huerfano County, and also in the bluffs along the San Juan River at Arboles, these rats often construct their nests entirely of the spiny branches of tree cactuses (*Opuntia arborescens* and *O. whipplei*).

A female wood rat which I surprised in her nest among the rafters of a cabin near Boulder, July 23, 1906, glided away like a shadow in the semidarkness, with two young about quarter grown clinging to her teats. Her movements were rapid but perfectly noiseless. A female collected by Loring at Loveland contained three small fetuses May 1, while an immature individual from near McElmo, June 18, is about two-thirds grown. Acorns, pinyon nuts, and juniper berries are the chief food of *fallax* in southern Colorado, judging from the quantities found in and around some of the nests.

This wood rat appears to be chiefly nocturnal, but as we rode down the bed of a dry desert arroyo north of Nucla, Montrose County, on a hot day in July, one was seen dodging about among the bordering rocks at midday.

Neotoma desertorum Merriam. Desert Wood Rat.

The small desert wood rat reaches Colorado in the extreme lower White River Valley, in the vicinity of Rangely (see fig. 14), where it meets the range of the larger, bushy-tailed *N. orolestes*. A number of the nests of *desertorum* were found on the first bench south of White River, 5 miles west of Rangely, at 5,300 feet, where four of the rats were collected September 15 and 16, 1906. These nests, or houses, were 2 or 3 feet in height, and were constructed of dried cow manure and the pads of prickly pear. Scattered here and there over the cactus flat they looked curiously like muskrat houses on a marsh. (See fig. 15.) The rats were trapped at the entrances to the nests, of which there were usually two above ground, and often a third opening beneath a bush a yard or so distant. The largest of the houses were in thickets of *Atriplex confertifolia*, but the smaller structures were reared in bunches of *Opuntia*. Specimens of *N. desertorum* and *orolestes* were taken within a few feet of each other, the latter species living in the banks of the dry arroyos which border the flat occupied by the small *desertorum*.

I did not find the species in the desert areas of southwestern Colorado in 1907, although much of the region seems suitable.

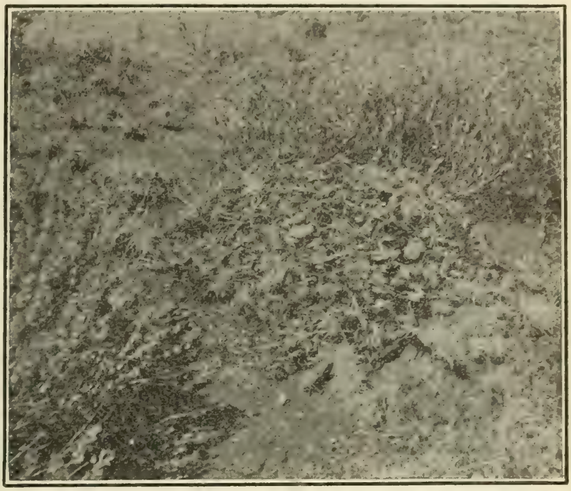

FIG. 15.—Nest of *Neotoma desertorum* on *Atriplex* flat near Rangely.

Phenacomys orophilus Merriam. Mountain Phenacomys.

An adult female *Phenacomys* which Warren collected December 11, 1906, at Lake Moraine, El Paso County, and forwarded to the Biological Survey for identification, proves referable to *P. orophilus* of the northern Rocky Mountains, and is quite distinct from *P. preblei*, taken on Longs Peak. The Lake Moraine specimen differs from the type of *preblei* in its larger size, more robust skull, and particularly in its much grayer pelage. The fur is full and long and of a beautiful frosted gray color, while the feet and tail are almost white. The measurements are: Total length, 140; tail vertebræ, 30; hind foot, 18. Warren secured this specimen near Ruxton Creek, at 10,250 feet, ''in a hole near creek bank.'' An imperfect skull in the National Museum which belongs to an alcoholic specimen (No. 59691, Fairplay, Park Co., July 11, 1873) is large and robust as compared with the skull of the type of *P. preblei*, and accords well with the Lake Moraine specimen. The skin has lost its color value through long immersion in alcohol. The altitude of Fairplay is about 9,900 feet.

Little is known of the habits of these interesting short-tailed mice. They appear to be very rare in Colorado and restricted to the mountains above 9,000 feet. At present they are known only from the higher eastern slopes of the Front Range, in the Canadian zone.

Phenacomys preblei Merriam. Preble Phenacomys.

Phenacomys preblei Merriam, Proc. Biol. Soc. Wash., XI, p. 45, March 16, 1897. Type from Lilie Mountain, near Longs Peak, Colorado.

The type of this small pale ochraceous species, an adult male, has until recently remained unique. It was collected August 12, 1895, by Mr. Edward A. Preble on Lilie Mountain (known also as Twin Peak), not far from Longs Peak. Preble states that the exact locality was on a southwest slope of the mountain not far from Lamb's ranch, at an elevation of approximately 9,000 feet. The specimen was taken in a trap set for white-footed mice among fallen logs on a dry slope supporting scanty vegetation. This slope had been covered by trees, most of which had fallen.

Another specimen, an adult female, from North Boulder Creek, near Nederland, has been recorded recently by Mr. R. T. Young,[1] who secured it on the Silver Lake trail September 19, 1900, at an elevation of between 9,000 and 10,000 feet. This specimen, which is in the Philadelphia Academy of Natural Sciences, I have been permitted to examine through the courtesy of Mr. Witmer Stone. It is a well-made skin and has a perfect skull, which is more robust than the skull of the type of *P. preblei*, with the interorbital ridges well developed (inclosing a median sulcus). The skin measurements are: Total length, 143; tail, 33; and hind foot, 18; as compared with 130–30–17 of the type of *P. preblei* (a male), and 146–38–19 of the type of *P. orophilus* (a female). In coloration the Nederland specimen is nearest *P. preblei*, it being much too yellowish for *orophilus*, with the back and sides strongly suffused with ochraceous.

Evotomys gapperi galei Merriam. Rocky Mountain Red-backed Mouse.

Evotomys galei Merriam, N. Am. Fauna No. 4, p. 23, pl. II, fig. 3, 1890. Type from Ward, Boulder County, Colorado (9,500 feet).

In Colorado red-backed mice are restricted to the boreal forests of the high mountains. Their center of abundance is in the lodgepole pine forest belt of the Canadian zone, but they range up to at least 11,000 feet, in the Hudsonian zone, well within the Engelmann spruce belt. Cold, mossy, heavily forested slopes having a great deal of fallen timber are most frequented by red-backed mice, which live beneath the rotten logs and brush piles. They seem to be largely nocturnal, although one July afternoon I saw one running along under a log at Petersons Lake, west of Eldora, Boulder County. In most parts of the mountains they are difficult to trap owing to the greater abundance of field mice and white-footed mice, which get into the traps early in the night. For this reason it is often impossible to judge whether red-backed mice are common or rare, but it seems certain that in most sections they are greatly outnumbered by other species. At the type locality, however, Preble found them abundant and caught nothing else in his traps.

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[1] Proc. Acad. Nat. Sci. Phila., p. 406, 1908.

During the field seasons of 1905 and 1906 eleven specimens were taken at four widely separated localities in northern Colorado. In July, 1905, five were trapped beneath fallen logs in dry lodgepole pine forest at Coulter, Middle Park (8,500 feet); three more were caught August 16 in a thicket of balsam (*Abies lasiocarpa*) in the aspen forest on the White River Plateau, 25 miles southeast of Meeker, at the same altitude; August 10, 1906, an immature male was secured in a bog near Pearl, in the northern end of North Park; and in late September three others were captured in the Douglas spruce forest at Baxter Pass, on the summit of the Book Plateau, within a few miles of the Utah boundary. In October, 1907, I found *Evotomys* tolerably common in mossy spruce woods and thickets near St. Elmo in the Saguache Mountains, at 10,000 feet. Most of the individuals trapped at this point were half or two-thirds grown. Other specimens are from Gold Hill, Longs Peak, Lake City, and Silverton.

The type of *E. galei*, which is in the Merriam collection, was taken by Mr. Denis Gale at Ward, July 13, 1889. The National Museum has specimens from the Silver Lake trail, near Nederland, Boulder County; and others labeled Twin Lakes and Del Norte.[1] Warren records this species from Crested Butte and Irwin, Gunnison County; Divide, Teller County; Lake Moraine, and mountains near Colorado Springs, El Paso County.[2]

Microtus pennsylvanicus modestus (Baird). Saguache Meadow Mouse.

Arvicola modesta Baird, Mamm. N. Am., p. 535, 1857. Type from "Sawatch Pass, Rocky Mountains" (Cochetopa Pass, Cochetopa Hills, Colorado).

This large, dark meadow mouse is common on the plains at the eastern base of the foothills and in the San Luis Valley region of southern Colorado, but is apparently rare in the northern mountains. Small colonies are found in marshes at Golden and Valmont, and at Medano Springs ranch, near the San Luis Lakes, the species was extremely abundant, not only in marshes and wet meadows, but also on grassy uplands and wherever any cover was afforded. A small colony of meadow mice found in an alkaline marsh near the mouth of Four-mile Creek, Routt County, and others reported in the McElmo Valley, in western Montezuma County, may have been of this species, but no specimens were secured at either locality.

In August, 1892, Loring collected a large series of topotypes at Tevebaugh's ranch, 9 miles south of Cochetopa Pass, where he found well-beaten runways ramifying through the tall grass near a creek. Six, seven, and even eight young were found by Loring in single nests, which were composed of fine dried grass and were said to resemble the nest of the ovenbird. Bailey found this meadow mouse very abundant in both dry and wet meadows along the Rio Grande at Del Norte, where it was doing slight damage in clover and alfalfa fields. At Wray,[1] in May, 1909, these meadow mice were feeding extensively upon the blossoms and leaves of the false Solomon's seal (*Vagnera stellata*), and fragments of the blossoms of a species of *Senecio* were also found scattered along the runways.

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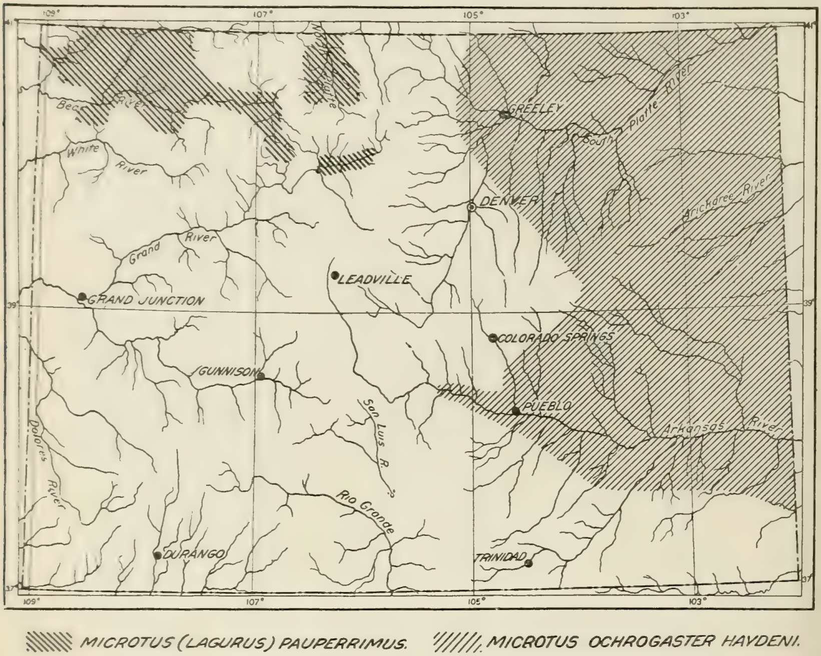
[1] Probably from some point in mountains near Del Norte.

[2] Mammals of Colorado, p. 249, 1906.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DENVER
GREELEY
South Platte River
Arickaree River
COLORADO SPRINGS
PUEBLO
Arkansas River
GUNNISON
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD
▨ MICROTUS (LAGURUS) PAUPERRIMUS.
▨ MICROTUS OCHROGASTER HAYDENI.

FIG. 16.—Distribution in Colorado of Hayden and pygmy field mice (*Microtus pauperrimus* and *M. ochrogaster haydeni*).

In addition to the series mentioned above, the Biological Survey has specimens of *M. modestus* from Denver, Loveland, Antonito, and Fort Garland. A specimen in the National Museum is from Twin Lakes; some from Fort Collins have been identified for S. Arthur Johnson; and Warren has others from Colorado Springs, Westcliffe, and Divide. The species is recorded from Estes Park.[2]

Microtus ochrogaster haydeni (Baird). Upland Mouse.

The upland mouse has been taken in Colorado at only a few localities along the eastern base of the foothills, and at Wray and Tuttle, near the eastern border. (See fig. 16.) It is doubtless present, however, over most of the dry uplands and prairies east of the mountains and north of the Arkansas Valley. Unlike *M. modestus*, which inhabits damp meadows and marshes almost exclusively, *haydeni* is usually, though not always, found on high grassy plains. On my trip across the plains from Cheyenne Wells to Sterling in 1909, I collected a young individual at Wray in a cold bog inhabited by a large colony of *modestus;* while at Tuttle four upland mice were taken in a marsh along the South Fork of the Republican River, and signs of them were seen on a grassy flat on the dry upland 8 miles south of Seibert. Other localities from which the Biological Survey has specimens are Loveland, Canon City, and Fort Collins. The species is reported from Greeley.[1]

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[1] Several specimens collected in the cool canyon bogs at Wray are abnormally dark, but can be matched by a few specimens from elsewhere in the range of *modestus*.

[2] Mammals of Colorado, p. 250, 1906.

Microtus mordax (Merriam). Rocky Mountain Field Mouse.

This large, long-tailed field mouse has been taken from an elevation of 4,600 feet (Grand Junction) to considerably over 12,000 feet (Mount Kelso),[2] and thus has the widest vertical range among the Colorado species of *Microtus*. It is abundant throughout the Canadian and Hudsonian zones of the mountains, and follows down cold streams in places through the Transition zone. It is of little economic importance, owing to the very limited agriculture carried on within its range.

This species is fond of forests and of cool, damp situations where the vegetation is rank. On Mount Kelso, near Grays Peak, several large colonies were discovered in dense thickets of alpine willows (*Salix chlorophylla* and *S. glaucops*) considerably above timberline. Most of my specimens were taken under logs in heavy forests or in cold mountain bogs grown up with willows. In many localities the field mice were so abundant that all the traps would be thrown by them during the early evening hours, and thus my chances for the rarer mammals were spoiled. I found a small colony at Rangely in a marsh bordering White River at 5,300 feet, and another on a small tributary of the San Miguel River near Coventry at about 5,500 feet. This species is represented in the Biological Survey collection by specimens from a wide range of localities in the mountainous parts of the State.

Microtus nanus (Merriam). Dwarf Field Mouse.

In Colorado this small field mouse is largely an inhabitant of the boreal zones and is common far above timberline on some of the mountain ranges. It is especially numerous in the high mountain parks of the northern two-thirds of the State, in dry, grassy sagebrush country. It does not appear to enter the surrounding forests to any extent, but occasionally may be taken along streams and in mountain meadows. I found several large colonies on the Front Range just south of James Peak, at an elevation of 12,500 feet, in October, 1906. An interminable labyrinth of runways extended through the moss in copses of an alpine willow (*Salix glaucops*), and many of the field mice could be seen darting from cover to cover. This species was very abundant in the spruce belt on Mount Kelso, at about 11,000 feet, and in places the mossy slope was almost honeycombed by the burrows. It was impossible to catch pocket gophers (*Thomomys fossor*) on Mount Kelso because of these mice, which used the gopher tunnels and were continually getting into the traps.

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[1] Mammals of Colorado, p. 251, 1906.

[2] Warren (The Mammals of Colorado, p. 100, 1910) states that he has seen a specimen from the Summit House on Pikes Peak, at 14,147 feet.

M. nanus is found as low as 6,000 feet in the meadows along White River, east of Meeker, and also near Coventry, Montrose County. In the last locality it is very abundant in the irrigated alfalfa fields, where it is considered very injurious. In the Hahns Peak region and in the parks on the western slope of the Gore Range these field mice were frequently observed in their runways in the daytime. At Coulter, Middle Park, I often watched them feeding on grass among the willows before the tent in the middle of the forenoon, and they seemed quite oblivious of my presence. On the grassy plains east of Como, South Park, this field mouse was using the abandoned burrows and tunnels of *Thomomys fossor* to a large extent.

Mr. Morris M. Green writes of a colony which he observed at Almont (8,000 feet), Gunnison County, in August, 1909: "There was a small colony of these animals in a little marsh, supporting a luxuriant growth of young cottonwoods, spearmint, and succulent, tender swamp grasses. Their runways in several places had little piles of tender grass stalks, cut to a length of 2 or 3 inches, which the little animals could doubtless manipulate easily in their paws. Two adults and three half-grown young were trapped. One runway led to a ball-shaped nest of dead grass under a dead log. The nest had not been frequented lately, and was doubtless a winter abode."

There are specimens from other localities as follows: Arrowhead, Mount Whiteley, Arapahoe Pass, Rabbit Ear Mountains, Estes Park, Cochetopa Pass, and Ruby Lake. Bailey records the species from Twin River and Twin Lakes.[1] Specimens taken by Warren at Crested Butte and Irwin, Gunnison County, have been identified by the Biological Survey.

Microtus (Lagurus) pauperrimus (Cooper). Pygmy Field Mouse.

In July, 1905, while traveling across the sage plains of eastern North Park, I detected evidences of a small species of *Microtus* (presumably a *Lagurus*) and later secured three specimens in the sand hills at the west base of the Medicine Bow Range, east of Walden.

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[1] N. Am. Fauna, No. 17, p. 31, 1900.

In 1906 an adult female was secured at the same locality; six specimens were collected at Elk Springs, 8 miles south of Lily, Routt County; eight were taken near Toponas, in Egeria Park; and the bleached anterior part of a skull was found in the nest of a wood rat near Douglas Spring, at the north base of the Escalante Hills. The above specimens compared with typical *M. pauperrimus* from northeastern Oregon show no differences.

This small, gray, short-tailed field mouse appears to have a somewhat interrupted distribution in northwestern Colorado. (See fig. 16.) Although much of western Routt County consists of sandy sagebrush country, well suited to the species, it was found in but two localities. In the sand hills east of Walden, North Park, the runways of these field mice were beneath the prostrate lowest branches of large clumps of *Chrysothamnus*, and that this is the chief food plant was attested by the many neat little piles of the smaller stems and leaves, cut into short lengths, here and there along the runways. At Elk Springs, on the watershed between Bear and White Rivers, a large colony occupied the grassy swale in which the springs are located, and extended for a considerable distance into the surrounding sandy sage plain. This colony probably numbered many hundreds, and the numerous runways ramifying in all directions formed a perfect network. The small colony near Toponas was located on the sage plain at the west base of the Gore Range, at an altitude of 8,000 feet, and was apparently subsisting largely upon range grasses. The members of this colony were very active during the early evening hours. In less than ten minutes, just after sunset one frosty October evening, three entered traps within a few feet of where I stood. Warren has taken this species at Hot Sulphur, in Middle Park. It has probably reached the open sage parks of Grand County from North Park, as the Gore Range would seem to be an effectual barrier on the west.

Allen has recorded this mouse from Kinney ranch, Sweetwater County, Wyoming,[1] which locality is within 30 miles of the Colorado boundary.

Fiber zibethicus osoyoosensis Lord. Rocky Mountain Muskrat.

Muskrats are reported in most of the streams of central and western Colorado below 9,000 feet, but I have found them common only in the marshes and lakes of the intermountain parks. In the chain of bogs and sloughs in the low meadows along Tomichi Creek, between Gunnison and Parlin, in October, 1907, muskrats were living in tule houses, and the many open trails ramifying through the moss and other vegetation on the surface of the ponds were evidence of their abundance. Muskrats were abundant in the San Luis Valley, especially in the San Luis Lakes. They were common in marshes along Grand River, in Middle Park, where I collected three specimens; two were taken near Hebron on the upper waters of the Platte, in North Park; and two more in a small tributary of the San Miguel River, near Coventry. Other specimens in the Biological Survey collection are from Tevebaugh's ranch, near Cochetopa Pass, secured by Loring in 1892.

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[1] Bull. Am. Mus. Nat. Hist., VIII, p. 248, 1896.

Fiber zibethicus cinnamominus Hollister. Great Plains Muskrat.

The muskrats of the eastern Colorado plains are referable to the pale reddish plains form *F. z. cinnamominus*, recently described from Kansas.[1] They are smaller and paler and have smaller skulls and teeth than the mountain form of central and western Colorado, *F. z. osoyoosensis.* Specimens from the eastern foothills are considered by Hollister to be *cinnamominus;*[2] others from Middle and North Park localities he refers to *osoyoosensis.*[3] I have no records of muskrats above 9,500 feet, and thus the high front ranges appear to be an effective barrier between the two forms in Colorado.

On the plains scores of muskrat houses may often be seen on a single marsh or lake. This is especially noticeable at Barr and other points in the lake region northeast of Denver. Although muskrats are present in most of the streams on the plains, their numbers are small compared with those inhabiting lakes and marshes. They are very troublesome in irrigated sections, as they are continually burrowing in the banks of ditches and reservoirs, often causing serious leaks.

This form is represented in the Biological Survey collection by specimens which I secured at Wray, Yuma County, and a female which contained eight small fetuses, taken by Loring in a small snow-fed lake at 9,500 feet, near Ward, Boulder County, June 8, 1893.

Castor canadensis frondator Mearns. Broad-tailed Beaver.

The identity of the Colorado beaver can not at present be determined, as no satisfactory specimens are available for study. Probably the beaver of the southern and western parts of the State is *frondator*, but those from the higher mountains in northern Colorado may prove referable to *canadensis.* Skulls from Lake Moraine and Crested Butte, sent to the Biological Survey for identification by Warren, are referred to *frondator.*

Very few beavers remain in the streams of the eastern plains region, where they were abundant in early times. Mr. A. E. Beardsley reports a few in the Platte River, 20 miles east of Greeley, according to Warren.[4] Throughout the mountainous parts of the State they are holding their own very well and in many sections appear to be increasing. This is due far more to the protection afforded them by ranchmen than to protective laws, which are often disregarded by trappers in the unsettled sections.

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[1] Proc. Biol. Soc. Wash., XXIII, pp. 125–126, Sept. 2, 1910.

[2] N. Am. Fauna No. 32, p. 31, 1911.

[3] Ibid., p. 26, 1911.

[4] Mammals of Colorado, p. 244, 1906.

In 1905 and 1906 beavers were reported in fair numbers on the headwaters of the Laramie River, the streams of Middle and North Parks, and on the upper Snake, Bear, and White Rivers and their affluents. They were said to be common also in the Ladore Canyon of Green River and in the Yampa Canyon of Bear River, many being trapped each winter. At Blanchard's ranch, 5 miles west of Boulder, in June, 1905, I found an aspen sapling freshly cut by a beaver, but was told that very few of the animals remained on Middle Boulder Creek. A thriving colony is located on Beaver Creek, a few miles above its junction with the South Boulder. When I visited this colony in October, 1906, it was being carefully protected by ranchmen. It extended along the creek for several miles, and all the dams were in good repair. A great many holes were discovered under the banks, and the majority appeared to be inhabited. Only one beaver lodge of recent construction was observed, and two or three dilapidated structures were in neighboring ponds. It was evident that the members of this colony were largely bank beavers.

In 1907 a few beavers were reported in the Cucharas River, a mile or two east of La Veta, and others in the same stream 4 miles south of La Veta. They were said to have formerly been abundant. Forest Ranger E. E. Chapson says a colony of four or five are living in the San Juan River on his ranch, 12 miles northeast of Pagosa Springs, but that beavers are uncommon on the upper waters of the San Juan. They have always been scarce in the streams heading on the western slopes of the La Plata Mountains, according to Mr. Steve Elkins, of Mancos, but were more common in some of the deep box canyons along the Dolores River, south of Paradox Valley. A few are still found on the lower Dolores, although a great many have been caught during the past 5 or 10 years. Along the Los Pinos, from Vallecito down nearly to Ignacio, beavers were reported as quite common, but I did not get an opportunity to examine any of their colonies, two or three of which are said to be located within a few miles of Bayfield. The beavers on this stream are trapped to a considerable extent despite protective laws. Mr. E. G. Bates, of Bayfield, considers them a nuisance in the lower Los Pinos Valley, as they are continually throwing dams across the large irrigation ditches, thus flooding much land and preventing the proper utilization of the water.

In 1892 Loring found beaver signs on Sangre de Cristo Creek, Costilla County, but reported that none of the animals were left in the vicinity of Fort Garland. In 1893 he found a large colony of beavers on Fall River, in Estes Park, counting 10 dams in a distance of 2 miles. Bailey reported a protected colony on the Alamosa River in 1904, and saw beaver work in the canyon of Conejos River, west of Antonito.

Allen reported beavers common in 1871 on the South Platte and its tributaries, in Park County,[1] and again in 1892 on the Florida, Animas, Mancos, and San Juan Rivers of southwestern Colorado.[2] In 1895 a colony of 8 or 10 beavers was living in a tule marsh within a stone's throw of the Union Station at Pueblo.[3] The Fur Trade Review (p. 242, 1901) quotes the Denver Times as stating that D. D. Finch, a ranchman living near Trinidad, found it necessary to apply to the State game commissioner for a permit to kill a number of beavers which had established themselves in the creek on his ranch. It is stated that the beavers cut down many of his fruit trees and dammed the creek so that it flooded the first floor of his house. Warren mentions a colony in Grand River, below Grand Junction,[4] and writes that in 1909, while passing through Hardscrabble Canyon, in the Wet Mountains, he saw considerable beaver work.

The habits of the beaver are too well known to require extended description. The quaking aspen is the tree most used by beavers in the Colorado mountains, both in the construction of dams and for food. The engineering skill in controlling water by means of dams displayed by a large colony of beavers on the Slate River at Crested Butte has been described in an extremely interesting article by Warren.[5] The work of beaver colonies on the Grand and White Rivers has been described by Barber.[6] The results of a close study of the work of a colony of beavers in the South Platte River near Littleton is given by Rockwell in the Denver Post of August 9, 1908.

Geomys lutescens Merriam. Yellow Pocket Gopher.

This interesting pocket gopher, the only representative of the genus in Colorado, has a wide range over the plains of the eastern half of the State. (See fig. 17.) It is very abundant in some sections and uncommon in others, the abundance and scarcity apparently depending largely upon the nature of the soil. It is most abundant in sandy areas, where the soft soil favors tunneling.

This species is the most injurious of the Colorado pocket gophers. It seriously damages the alfalfa crop by eating the roots, while the numerous mounds of earth thrown up by the animals in alfalfa fields and meadows also dull the mowing machine sickles and cause great loss of time to ranchmen during the haying season. At Wray,

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[1] Bull. Essex Inst., VI, p. 56, 1874.

[2] Bull. Am. Mus. Nat. Hist., V, p. 81, 1893.

[3] See Forest and Stream, pp. 43–44, 1895.

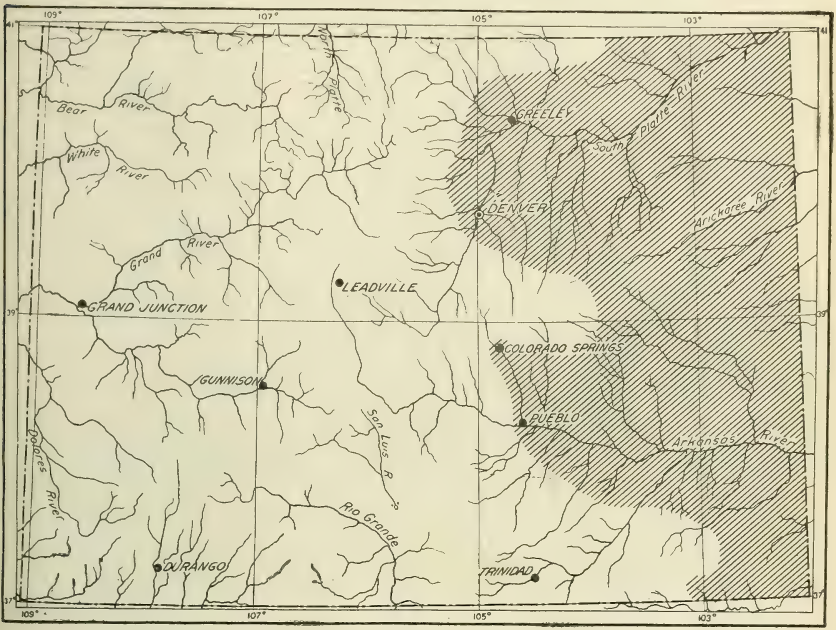
[4] Mammals of Colorado, p. 244, 1906.

[5] Proc. Wash. Acad. Sci., pp. 429–438, 1904.

[6] Am. Nat., XI, pp. 371–372, 1877.

Yuma County, this gopher is reported very destructive to orchards planted in sandy soil, as it cuts the roots of a great many young trees and frequently kills even those of large size.

On the western end of the Arkansas Divide, in northern Weld County, and perhaps elsewhere along the eastern base of the foothills, *G. lutescens* occupies considerable territory adjacent to the range of *Thomomys clusius*. Both gophers were taken on the grassy plateau north of the Chimney Cliffs in northwestern Logan County within 2 miles of the Nebraska boundary at 5,100 feet. *Geomys* is prevalent on the Arkansas Divide as far west as Eureka Hill, while *Thomomys* is the gopher found south of Seibert. Over a wide area on the southeastern plains *G. lutescens* occurs with *Cratogeomys castanops*. In the vicinity of Lamar it is abundant in sandy country, while *Cratogeomys* is largely restricted to hard-soil flats. Streator found *lutescens* common in sandy river bottoms at both Pueblo and Limon.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LEADVILLE
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD

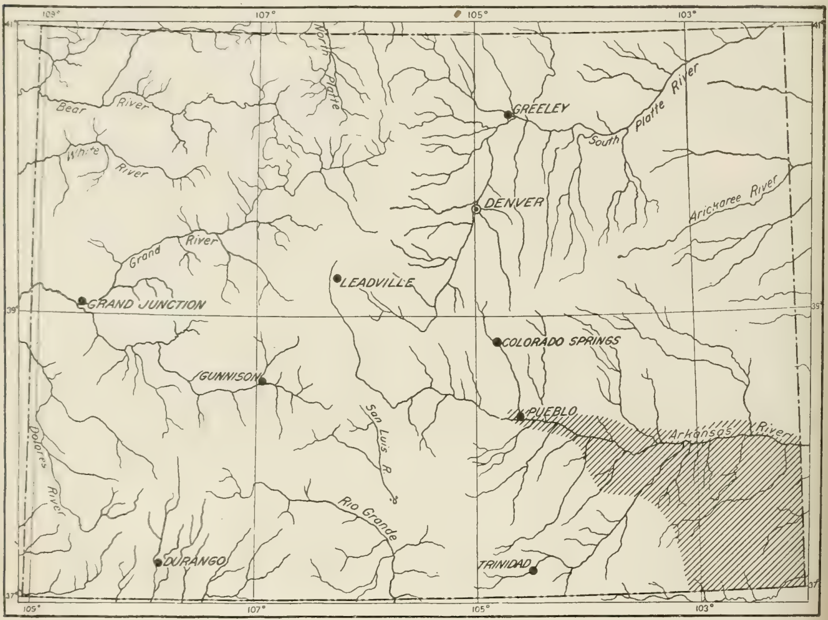
FIG. 17.—Distribution in Colorado of yellow pocket gopher (*Geomys lutescens*).

There are specimens of *G. lutescens* from Loveland, Valmont, Sterling, Avalo, Seibert, Pueblo, Limon, Burlington, Hugo, Kit Carson, Twin Buttes, Chivington, and Las Animas. Other localities represented in the Warren collection are Monon (Baca County) and Colorado Springs. A specimen collected at Denver by Mr. W. D. Hollister has been identified by the Biological Survey.

Cratogeomys castanops (Baird). Chestnut-faced Pocket Gopher.

Pseudostoma castanops Baird, Rept. Stansbury's Exped. to Great Salt Lake, p. 313, 1852. Type from near Bents Fort, Colorado (near present site of Las Animas).

The large chestnut-faced gopher has not been taken much north of the type locality, and the Arkansas Valley marks in a general way the northern limit of its range. (See fig. 18.) Mr. C. E. Aiken, of Colorado Springs, has a mounted specimen taken near the reservoirs several miles north of Lamar, but the species appears not to reach Arlington and Chivington on the line of the Missouri Pacific Railroad. From this latitude (about 38° 15′) the species ranges southward to Chihuahua, Mexico.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PUEBLO
Arkansas River
San Luis R.
Dolores River
Rio Grande
DURANGO
TRINIDAD

FIG. 18.—Distribution in Colorado of chestnut-faced pocket gopher (*Cratogeomys castanops*).

The type specimen in the United States National Museum was collected on the "prairie road to Bents Fort," which would be near the present site of Las Animas, whence the Biological Survey has a series of topotypes. Other specimens are from Olney and from La Junta (18 miles south). Warren has the species from the following localities: Lamar; Monon, Baca County; Irwin's ranch, Las Animas County; and 3 miles west of Pueblo.

C. castanops may be distinguished at once from the yellow pocket gopher (*Geomys lutescens*), which is found with it over most of southeastern Colorado, by its much larger size and unisulcate upper incisors. It is usually found on hard-soil flats, while *G. lutescens* prefers sandy strips of country and soft soils. The characteristic large flat earth heaps of *Cratogeomys* were seen in abundance on the high plains from Lamar south to Springfield, in Baca County, and thence northwest to Gaume's ranch, in Shell Rock Canyon, and north to Caddoa Station, Bent County. This gopher came under my observation in a cattle and sheep grazing region where there is little land under cultivation and where it is not the pest that it is in agricultural sections.

Thomomys talpoides agrestis Merriam. San Luis Pocket Gopher.

Thomomys talpoides agrestis Merriam, Proc. Biol. Soc. Wash., XXI, p. 144, June 9, 1908. Type from Medano ranch, San Luis Valley, Colorado.

This large pale gopher was found in abundance in the hay meadows bordering Medano Creek at the Medano Springs ranch, near the San Luis Lakes, in October, 1907. The piles of earth thrown up average larger than those of any other species of *Thomomys* found in Colorado, a few being noted fully 4 feet in diameter and a foot high, and they are so numerous as to give a dotted appearance to the closely mown meadows. These large earth heaps prove a great hindrance in harvesting hay, as they clog and dull the mowing machine sickles very rapidly. A white, frosted appearance is presented by many of the gopher hills which have been thrown up by animals tunneling in extensive alkaline deposits, but over most of the meadows the piles are of rich black loam. While most abundant on low ground at Medano ranch, a few gophers inhabit the low, sandy, cactus-covered hummocks which surround the marshes and meadows. I found them very difficult to catch, as they nearly always covered my steel traps with earth and stopped up the tunnels for some distance from the traps.

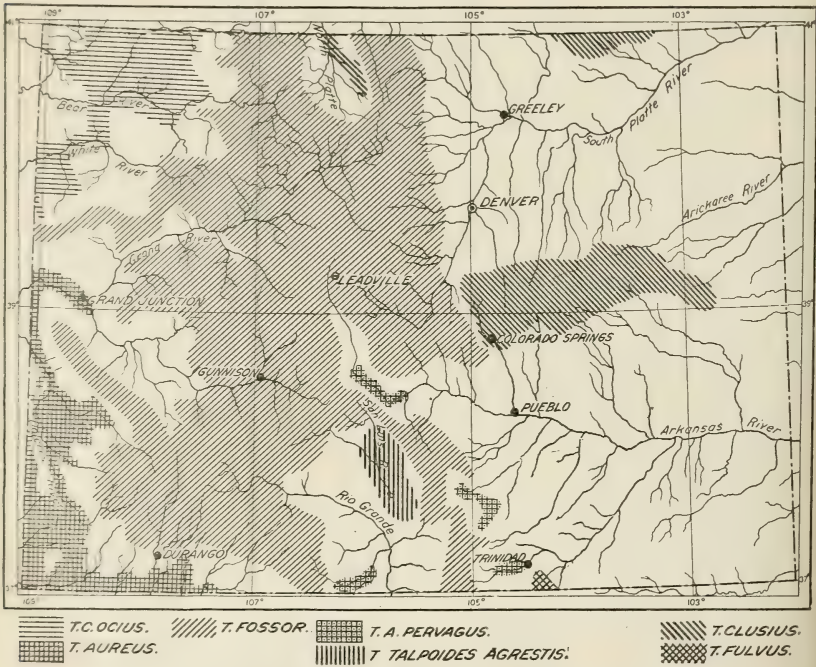
In traveling northeast from Mosca to the Medano ranch we detected no signs of gophers until we reached the meadow lands southeast of the San Luis Lakes. The characteristic large hills were not seen near Hooper nor in staging from Moffat northwest to Saguache, but were tolerably common in the alkaline soil along the railroad near Moffat and to a point 12 miles north of there. In 1909 Warren secured specimens of *T. agrestis* at Crestone, at the western base of the Sangre de Cristo Range, and others on Mosca Creek. The species thus appears to have a restricted range in the northeastern part of the open San Luis Valley (see fig. 19), but the limits and area of its dispersion are as yet unknown, as are also its food habits. Large sandy areas in the valley appear to be entirely uninhabited by pocket gophers. It is highly interesting to find in the large intermountain San Luis Valley a gopher with relationships nearest *talpoides* of the northern Great Plains. Careful collecting in the Rio Grande Valley of northern New Mexico and on the high mountain barriers on the east and north sides of San Luis Valley make it reasonably certain that *agrestis* is entirely isolated.

The following characterization will serve to distinguish *agrestis* (from original description, l. c.):

"*Characters.*—Size and general characters much as in *talpoides*, but color very different—pale drab as in *ocius* instead of dark brown as in *talpoides;* skull also different.

"*Color.*—Upperparts uniform drab, sometimes with a pale reddish (dull ochraceous) cast on top of head and neck; ear spots conspicuously dusky; underparts soiled whitish, the plumbeous underfur showing through.

"*Cranial characters.*—Skull similar to *talpoides*, but averaging longer and narrower; zygomata less spreading; nasals less regular, less truncate posteriorly, less straight on outer side—tending to spread outward on posterior third; premaxillæ longer and broader posteriorly; maxillary root of zygomata longer and broader and swollen to articulation with jugal so that the jugal part of arch is abruptly and conspicuously narrower; bullæ slightly more swollen.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GUNNISON
PUEBLO
Arkansas River
Rio Grande
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TRINIDAD
37°
T. C. OCIUS.
T. AUREUS.
T. FOSSOR.
T. A. PERVAGUS.
T. TALPOIDES AGRESTIS.
T. CLUSIUS.
T. FULVUS.

FIG. 19.—Distribution in Colorado of pocket gophers (genus *Thomomys*).

"*Measurements.*—Type: Total length, 220; tail vertebræ, 57; hind foot, 30. Average of 4 females from type locality: Total length, 212; tail vertebræ, 55; hind foot, 29."

Thomomys clusius Coues. Coues Pocket Gopher.

This species extends into North Park from the north, and east of the mountains is common on the high plains of northeastern Weld and northwestern Logan Counties. Toward the south it is again common on the higher western end of the Arkansas Divide, from a point 8 miles south of Seibert west to the base of the mountains near Colorado Springs. (See fig. 19.) The distribution on the plains between the Arkansas Divide and northeastern Weld County is unknown, there being no specimens from the intervening region. Specimens from the lower foothills of Jefferson, Boulder, and Larimer Counties are apparently intermediate in some respects between *T. clusius* and *fossor* of the higher mountains, which indicates a probable continuity of range on the plains at the eastern base of the foothills from the Wyoming boundary south to the Arkansas Divide. Throughout its range *T. clusius* is mainly an inhabitant of high plains and open foothill country in the Transition zone.

This gopher was found sparingly in the sand hills east of Canadian Creek, North Park, at the west base of the Medicine Bow Mountains. In July it was feeding largely upon a species of lupine (*Lupinus alpestris?*), and large caches of the stems and leaves of this plant were found in some of the burrows. North Park specimens accord well with typical *clusius* from Bridgers Pass, Wyoming. This gopher is apparently rare in North Park, since it was found at no other point.

The Coues gopher is the dominant species on the high plains of northeastern Weld and northwestern Logan Counties. At Chimney Canyon, some 30 miles northwest of Sterling, where I collected five specimens on the grassy plateau which forms the summit of the Chimney Cliffs, at 5,100 feet elevation, *Geomys* also was sparingly present. *Thomomys* was the only gopher found at Pawnee Buttes, some 30 miles southwest of Chimney Canyon, and thence westward and northward to the Wyoming boundary north of Grover. It is probably the dominant gopher over all the high grassy watershed between Horsetail and Lodge Pole Creeks, including a small area in extreme western Nebraska.

On the Arkansas Divide the eastern limit of its range appears to be 8 miles south of Seibert, where a specimen was taken from a small colony in hard soil on the north slope, at about 4,500 feet. From this point the species has a continuous range westward on this high watershed to the base of the foothills. Streator found it abundant at Limon and Flagler, and Warren states that it is tolerably common on the plains at Colorado Springs, occurring there with *Geomys lutescens*.[1]

Thomomys clusius ocius Merriam. Green River Pocket Gopher.

On the sage plains of western Routt and Rio Blanco Counties this pale grayish form is the only pocket gopher present. It is abundant in the lower valleys of the Snake, Bear, and White Rivers, and in Browns Park, on Green River. On the watersheds between these valleys, however, it occurs only in scattered colonies, usually in sandy strips of country. At no point was this gopher found much above 6,000 feet. Baggs Crossing appears to be the eastern limit of its range in the Snake River Valley, while the boreal-capped escarpment of the Book Plateau forms an effective barrier to its southward dispersion. (See fig. 19.) In all the high mountainous country on the south and east of its range *T. ocius* is replaced by *T. fossor*. The ranges of the two do not appear to meet, however, and there is a region of varying width in which no gophers were found.

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[1] Mammals of Colorado, p. 252, 1906.

Gopher hills were abundant on the divide southwest of Rangely, and a few were seen near the Utah boundary in the valleys of Texas and Evacuation Creeks. A specimen taken on Bear River, south of Lay, August 8, and another from Snake River (15 miles northeast of Sunny Peak), August 24, are in short reddish summer pelage. September specimens from Ladore, Lily, Elk Springs (8 miles south of Lily), and Rangely are in the full grayish winter coat. The anterior part of a bleached skull was found in a wood-rat nest at Douglas Spring, at the north base of the Escalante Hills.

In the river valleys, where *ocius* is most abundant, ranchmen do not consider it very injurious, since it prefers sandy and waste soil and greasewood flats to meadow land and alfalfa fields.

Thomomys fossor Allen. Colorado Pocket Gopher.

Thomomys fossor Allen, Bull. Am. Mus. Nat. Hist., V, p. 51, 1893. Type from Florida, La Plata County, Colorado.

The general distribution of this dark-brown, medium-sized species in the Colorado mountains is indicated by specimens from a wide range of localities. It is the only gopher found in the higher mountains and occurs regularly from 7,000 feet to 13,000 feet, both in heavy forests and on the open slopes far above timberline. It is common as low as 7,000 feet in the yellow pine forests of Archuleta, La Plata, and other southwestern counties, but at few points does it range much below the Canadian zone. (See fig. 19.) The greatest numbers are found in the aspen belt of the Canadian zone, where the numerous fresh hills of earth thrown out each night attest to the great activity of the animals in the rich black soil. (See fig. 20.) The lower limits of range are roughly indicated by Florida, Pagosa Springs, Sapinero, Hayden, Meeker, Elkhorn (Larimer County), and foothills near Boulder and Golden. Gophers from the lower eastern foothills of the Front and Medicine Bow Ranges are not typical, and they show an approach toward *clusius* of the higher plains.

Ranchmen in the foothill valleys and mountain parks suffer considerable loss through the depredations of these animals, and every year a large acreage of alfalfa is killed by gophers cutting the roots just beneath the surface of the ground. In the spring of 1905 Mrs.

Blanchard, living 5 miles west of Boulder, discovered, 3 inches below the surface, a cavity in which a gopher had a store of nearly 50 tiger-lily bulbs, evidently gathered the previous fall. The cavity was nearly full and the bulbs were scattered through loose earth, which had been thoroughly worked over. A tunnel led directly from the cache to the flower bed a rod or so distant. Near Golden this gopher is said to make itself a nuisance by burrowing in the banks of irrigation ditches and reservoirs, and this is probably true in other sections along the lower edge of its range. The numerous hills of earth and stones thrown up in hay meadows and grain fields dull the sickles of mowing and harvesting machines.

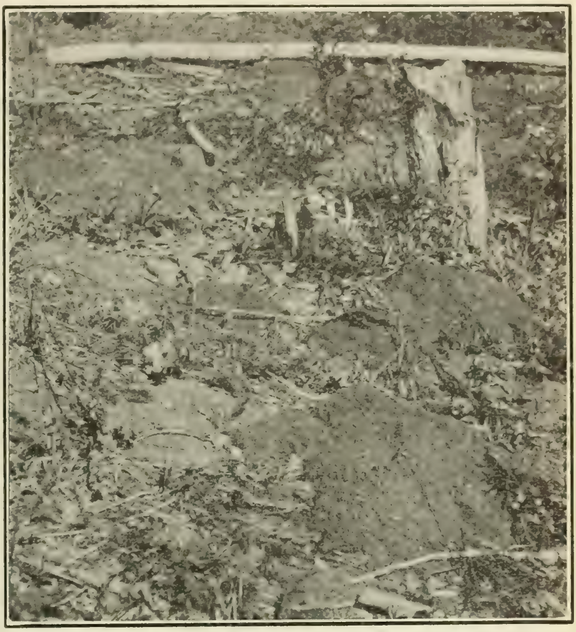


FIG. 20.—Earth heaps of Colorado pocket gopher (*Thomomys fossor*) on Book Plateau, at 8,000 feet.

As an offset to the injury inflicted upon agricultural interests along the lower edge of its range, *T. fossor* is an important agent in the conservation of forests and moisture in the higher mountains, where it is most abundant. The thorough and continual working and enriching which the soil receives through the activities of gophers is highly beneficial to forest growth, and at the same time a large amount of moisture which would otherwise run off the mountain slopes is retained in the numerous burrows and underground tunnels which might properly be termed natural water traps.

On the higher open mountain slopes, particularly above timberline, one often sees peculiar long serpentine ridges of earth, sometimes dry and hard packed, but more often partially disintegrated through the action of moisture. These are formed by gophers during the winter when snow covers the ground to a considerable depth. The loose earth thrown out is packed into the ramifying tunnels which the animal has made through the snow on the surface of the ground.

Thomomys fulvus (Woodhouse). Fulvous Pocket Gopher.

A female from Fisher Peak, southeast of Trinidad, is referable to this species. It was collected September 15, 1903, at an elevation of 8,000 feet, by Mr. A. H. Howell, who states that gophers were tolerably common in the parks on the upper slopes of Fisher Peak, in the Transition zone. This gopher probably reaches Colorado only in the Trinidad region (see fig. 19), although it has been taken at a number of points in the foothills of northern New Mexico just south of the Colorado line.

Thomomys aureus Allen. Golden Pocket Gopher.

The golden pocket gopher is found in the low valleys of southwestern Colorado from the lower Grand River Valley southward in the Upper Sonoran zone. In a general way it occupies the valleys and lower flats south and west of the San Juan and La Plata Mountains and the Uncompahgre Plateau (see fig. 19), but as it has been taken at Grand Junction, it may cover a considerable area in the lower Gunnison Valley. In 1907, however, I saw no signs of pocket gophers at any point in either the Gunnison or Uncompahgre Valley. Gophers seem to be absent or very scarce in the Grand Valley also, as in following along Grand River from the Utah line to Rifle, a distance of 100 miles, I neither saw nor heard of any.

There are in the Biological Survey collection specimens of *T. aureus* from Arboles; Bayfield; Mesa Verde, northern end, 8,100 feet; Ashbaugh's ranch, near McElmo; Coventry; and Grand Junction. The Grand Junction specimen, taken November 7, 1895, by Mr. A. H. Howell, is an adult female in beautiful golden gray winter pelage. The others from Colorado are all June and July specimens, a June male from Arboles being darker than typical *aureus*.

At Bayfield, Ashbaugh's ranch, and Coventry these gophers are abundant, and are reported to be very injurious in grain and alfalfa fields. They are stated to be very destructive also to young orchards near Bayfield, as they cut off the roots of the trees. They reach their upper limit along the Los Pinos in the pinyon country near Bayfield at 6,500 feet, all the yellow pine belt north of that point being occupied by *T. fossor*. Along the San Juan River they are found as far east as Arboles, where they are common in sandy soil along the railroad track. In the Coventry region these gophers are very numerous on the cultivated flats between the San Miguel River and Naturita Creek, extending up to about 6,500 feet. They are a great nuisance in this irrigated section, tunneling in the banks of ditches and reservoirs and causing numerous and often serious leaks. In the arid desert region along the lower San Miguel and Dolores Rivers gophers are very scarce, the only signs noted being at the Dolores River crossing in Paradox Valley and at Uranium in Sinbad

Valley, and these workings were not fresh. They are a pest at Ashbaugh's ranch in the valley of McElmo Creek, but apparently do not inhabit the bordering mesas. Many ranchmen keep a number of cats purposely for killing gophers, and a great many of the animals are drowned out when the fields are irrigated. Mr. George J. Ashbaugh attributes to pocket gophers the holes which he occasionally finds eaten into watermelons from beneath.

Gopher mounds were abundant on the northern end of Mesa Verde, between 7,500 and 8,100 feet, in the Transition zone, and a specimen collected June 14 at 8,100 feet is referred to *aureus*. This seems to be the only Colorado record for this species in the Transition zone. The workings were in soft soil, either among sagebrush, or in the small grassy parks scattered here and there among the dense chaparral of oak and June berry. No signs of gophers were found among the pinyons on the southern end of Mesa Verde below 7,500 feet. Gopher hills seen in alfalfa fields just west of Mancos, and also in the bottom of the Dolores Canyon, 2 miles east of Dolores, were the characteristic large earth mounds of *aureus*.

Thomomys aureus pervagus Merriam. Espanola Pocket Gopher.

This large species is the most richly colored of the Colorado pocket gophers. It was described from Espanola, Santa Fe County, N. Mex., and is known to range north as far as Salida, in the lower end of the upper Arkansas Valley. The distribution between these two points has not been worked out in detail, but specimens from the Huerfano Valley at Gardner and from Antonito and the Conejos River Canyon, 10 miles west of Antonito, indicate a range in the foothill valleys along the east sides of both the Sangre de Cristo and San Juan Ranges, chiefly in the Upper Sonoran zone. (See fig. 19.)

It is impossible to state from present knowledge how this species has reached the upper Arkansas Valley, or whether, indeed, continuity of range exists. It is reasonably certain, however, that it does not cross the 9,000-foot Poncha Pass from the San Luis Valley, as the Poncha Pass region, which is practically in the Canadian zone, is occupied by *T. fossor*. The characteristic large hills of *T. pervagus* were seen in abundance on the sandy flats in widenings of the Arkansas Canyon from Salida down to Texas Creek Station; but the Grand Canyon of the Arkansas, beginning a few miles below Texas Creek and culminating in the stupendous chasm of the Royal Gorge, must certainly separate *pervagus* from the gophers inhabiting the Upper Sonoran country around Canon City, at the lower end of the canyon. It remains to determine the species occurring in the Arkansas Valley near Canon City, and thence south along the eastern base of the Wet Mountains, but logically it should be *pervagus*, as this is the gopher abundant in the Huerfano Valley from Badito west to Gardner.

Apparently, also, this is the form whose large hills were so common in the Cucharas Valley from Walsenburg up to La Veta, and between Trinidad and Weston in the upper Las Animas Valley. In going from Texas Creek to Westcliffe and thence overland south to Gardner, the small hills of *fossor* were the only signs of gophers noted, and these were found chiefly in the high Wet Mountain Valley. Over a wide strip of mixed yellow pine and pinyon country south of the Arkansas River at Texas Creek, and also on the southern slopes of the divide connecting the Wet Mountains with the Sangre de Cristo Range, no gophers appear to be present.

In the San Luis Valley, *T. pervagus* is known only about its southern end. Just how far north it extends along the eastern base of the San Juan Range is not known. The large gopher hills which Bailey found abundant along the Rio Grande at Del Norte may have been either *pervagus* or the pale *T. agrestis* described from Medano Springs ranch, near the San Luis Lakes, the range of which also is very imperfectly known. I saw no gopher work near Saguache.

Throughout its range *T. pervagus* revels in the rich mellow soil of the stream valleys, or occupies the sand flats along the lower bordering slopes, as in the Arkansas Valley above Salida. In the Cucharas, Huerfano, and Las Animas Valleys these gophers frequent alfalfa fields, throwing out the rich brown or reddish soil in large hills, often 3 feet or more in diameter, which must prove a great hindrance in harvesting the crop, aside from the serious injury which the animals inflict upon the alfalfa itself by eating the roots, of which they are very fond.

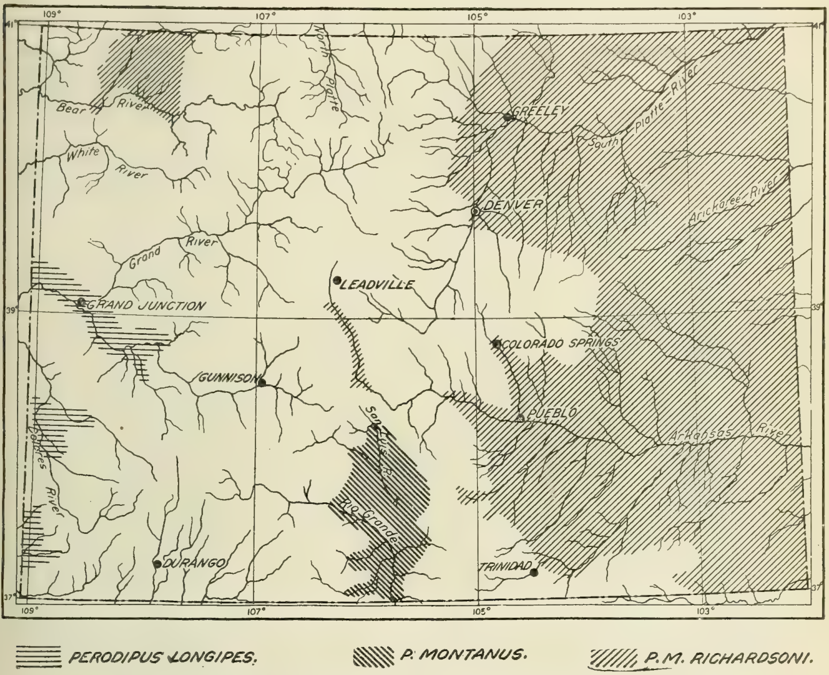
The Salida specimens were collected at Sand Park, the sandy eastern slope of the Arkansas Valley a mile north of the town. The gopher hills were common in this strip of country, both along the embankments of the Denver & Rio Grande Railroad near the river, at a little over 7,000 feet, and up to the lower edge of the pinyons 400 or 500 feet higher, but they were not noted in the adjoining adobe soil. They were usually thrown up among the bunches of prickly pear (*Opuntia polyacantha*) or beneath *Chrysothamnus* and *Atriplex* bushes. One of these shrubs at least, *Atriplex canescens*, forms a part of the animal's food, as in one of the underground tunnels was a cache of its stems and leaves.

Specimens from Salida and Gardner, taken in early November, are in beautiful full reddish-brown winter pelage, with a considerable coal black area on chin, lips, and throat. An immature Gardner specimen has the sides of the throat strongly suffused with reddish-orange, and this suffusion is more or less indicated in all the adults.

Perodipus montanus (Baird). San Luis Kangaroo Rat.

Dipodomys montanus Baird, Proc. Acad. Nat. Sci. Phila., VII, p. 334, 1855. Type from old Fort Massachusetts (near Garland), Colorado.

This peculiar Upper Sonoran mammal inhabits the sandy areas in the San Luis Valley (see fig. 21), and thence extends south into the high valleys and parks of northern New Mexico. It is one of the highest ranging species of the genus, in the San Luis Valley occurring up to 7,900 feet and possibly a little higher, and throughout its range it is restricted to the mountain valleys. The type of *montanus*, in the National Museum, was collected in 1853 by F. Kreuzfeldt, on Capt. Beckwith's expedition. In addition to a large series of topotypes from Fort Garland, the Biological Survey has specimens from Antonito; Conejos River, 10 miles west of Antonito; and Medano Springs ranch, near the San Luis Lakes. Warren has taken the species at Crestone.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Colorado Springs
Pueblo
Arkansas River
San Luis R.
Rio Grande
Dolores River
Durango
Trinidad
PERODIPUS LONGIPES.
P. MONTANUS.
P. M. RICHARDSONI.

FIG. 21.—Distribution in Colorado of kangaroo rats (genus *Perodipus*).

The characteristic burrows are tolerably common along the railroad at Moffat, and thence northwest to a point 6 miles southeast of Saguache, and kangaroo rats are said to be occasionally plowed out in the fields at Saguache. In going north from Moffat the burrows were often noted in the gravelly soil along the railroad near the hot springs, but the only signs of kangaroo rats seen farther north were two fresh burrows in sandy soil a mile south of Villa Grove, at an elevation of 7,900 feet—a point doubtless very near the northern limit of the species. The high Poncha Pass country effectually separates *montanus* from *P. richardsoni* of the upper Arkansas Valley.

At Fort Garland Loring found this species abundant in a cultivated field, but absent from the sagebrush country. Bailey reported it very common in the Rio Grande Valley at Alamosa and Del Norte and in the Conejos River Canyon. A specimen taken on Conejos River had its cheek pouches filled with the heads of gramma grass. Del Norte is apparently very near the western limit of *montanus* along the Rio Grande, as I saw no signs above that point.

Kangaroo rats are stated to have been very numerous at Mosca some years ago when only small areas were under cultivation. At that time they were very injurious to crops, digging up large quantities of newly planted grain and caching it in their burrows along the sandy margins of the fields, and also feeding extensively on tender green stems of wheat. Of late years the rats have been largely driven out of the central part of the San Luis Valley by extensive cultivation and irrigation, and now are gathered in the sandy uncultivated parts, particularly in the sandhills along the western base of the Sangre de Cristo Range from Garland north to Crestone. According to cowboys they are so numerous in the Luis Maria Baca grant, south of Crestone, that their burrows and tunnels completely undermine the sandy ground in many places and make riding difficult and even dangerous.

At the Medano ranch kangaroo rats were found chiefly in the sandy hummocks just southeast of the headquarters. The burrows were usually beneath *Sarcobatus* or *Atriplex* bushes, or in beds of prickly pear (*Opuntia*), and more rarely under the large rabbit brush (*Chrysothamnus patens*). As with other species of kangaroo rats, there are usually from three to six entrances to a nest, each entering the ground at an angle of less than 45 degrees, sometimes nearly horizontally, and usually from different directions. Kangaroo rats are nocturnal as a rule, but I caught one individual in a trap during the daytime at the Medano ranch, and early one morning before sunrise saw another dart into its burrow, leaving a tiny cloud of dust behind.

Perodipus montanus richardsoni (Allen). Richardson Kangaroo Rat.

This interesting species is represented by a large series of specimens, chiefly from east of the mountains on the plains, where it is generally distributed. It occurs also over parts of the sandy sage plains of northwestern Colorado, in Routt County, reaching that region from the Wyoming plains on the north. (See fig. 21.) It follows some of the warm Upper Sonoran valleys into the eastern foothills of the front ranges, the upper limits being indicated by Arkins, Larimer County; Twin Lakes; Salida; 8 miles west of Gardner, Huerfano County; and La Veta.

In northwestern Colorado kangaroo rats occur sparingly in the sandy bottoms along Bear River south of Lay; and also near the Wyoming boundary, a few miles southwest of Baggs Crossing. In the lower valley of Snake River and throughout the sandy sage plains north of Bear River they were found in abundance. At no point were they noted much above 6,000 feet. The greatest numbers were found on the east side of Snake River, near Sunny Peak. Here a large colony occupied a sandy strip of country abounding in blow-outs, and the burrows were either in the banks of these or beneath bushes of *Atriplex confertifolia* or *Grayia spinosa*. Specimens from northwestern Colorado are referable to *P. richardsoni*, although they average a little smaller than the typical form and have weaker maxillary arches—in these two respects approaching *P. montanus* of the San Luis Valley.

During a trip from Cheyenne Wells northwest across the plains to Sterling and Grover I found kangaroo rats generally distributed in all sections having sandy and soft soils. Our night camp, June 2, some 20 miles northwest of Sterling, was near an old sod corral, the sides of which had tumbled down and partially disintegrated. The soil here was soft and easily excavated and had attracted hundreds of kangaroo rats, whose burrows fairly honeycombed the ground. A small number of traps put out here secured 12 specimens.

Kangaroo rats are abundant at Gardner, in the Huerfano Valley, both on sandy flats along the river and on the low adjoining benches. The burrows at this point were usually beneath chico brush (*Atriplex canescens*), and after a 2-inch snowfall during the night of November 18 I saw the peculiar round tracks made by a few which had come out of their burrows during the night and skipped about on the fresh snow. The leaps taken when running are long, often 3 or 4 feet. Kangaroo rats are reported along Muddy Creek, 8 miles west of Gardner. In the Cucharas Valley they are common at Walsenburg, and a very few burrows were found at La Veta.

In November, 1907, I found kangaroo rats exceedingly numerous on the gently inclined sandy slopes lying along the east side of the Arkansas River, just north of Salida; and I saw from the train near Howard and Cotopaxi, farther down the river, burrows which I attributed to this species. Mr. J. W. Frey states that the rats are found north to Browns Canyon, 7 miles above Salida, and west to Poncha Springs. Kangaroo rats were most abundant at Salida among the *Chrysothamnus* bushes, Russian thistles, and in beds of *Opuntia polyacantha*, on the upper sand slopes just below the edge of the pinyons, between 7,100 and 7,400 feet. The Salida series is not typical *P. richardsoni*, but is much nearer to that species than to *montanus* of the San Luis Valley. A Twin Lakes specimen recorded by Coues and Yarrow[1] as "*Dipodomys phillipsi ordi*" was collected by Dr. J. T. Rothrock in August, 1873, and if correctly labeled is an important record because of the high elevation. The Royal Gorge, and in fact much of the Grand Canyon of the Arkansas, would seem to prevent continuity of range from the plains; but it is evident that the kangaroo rats of the upper Arkansas Valley reached that region by way of the Arkansas drainage area, apart from all physiographic considerations, since their relationship is clearly with *richardsoni*.

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[1] Expl. W. of 100th Mer., V, p. 109, 1875.

The typical home of the kangaroo rat is in sandy river bottoms or on the numerous sand ridges scattered here and there over the plains. It is seldom found living in hard soils, but often takes up its abode in cultivated fields. The more or less horizontal burrows are excavated beneath bunches of prickly pear, yucca, and sagebrush, or in the banks of blow-outs and railroad embankments. The animals are nocturnal and most active during the latter part of the night. During the day the burrows are often closed from within, but early in the morning they are usually found open, with a quantity of freshly ejected sand at the entrances. Their food consists of various seeds, and the stems of grass and wheat are often found in the capacious external cheek pouches. The pouches of a specimen collected at Salida early in November contained about equal quantities of the leaves of *Atriplex canescens* and the seeds of a species of *Chrysothamnus*.

Perodipus longipes (Merriam). Moki Kangaroo Rat.

Kangaroo rats from Fruita, Grand Junction, Hotchkiss, and Ashbaugh's ranch (McElmo Valley), show no departure from typical *P. longipes* from the Painted Desert, Arizona. Others from Coventry and Naturita in the San Miguel region, at a somewhat higher elevation, average darker than typical specimens, but, as they accord well in other essentials, are not considered separable.

The Moki kangaroo rat is a creature of the sandy desert areas of the southwest and is normally restricted to the lowest and warmest parts of the Upper Sonoran zone. It reaches Colorado along the Colorado River Valley, the northern limit of range being marked by the Book Cliffs (see fig. 21), which separate it from *P. richardsoni* of the northern plains.

By reason of the extensive cultivation of the lower Grand Valley during recent years, kangaroo rats now occupy less ground than formerly. They are found chiefly in the narrow strip of rough uncultivated country lying at the southern base of the Book Cliffs, and on the desert northwest of Mack. In the arid valley of West Salt Creek, between Mack and Carbonera, the characteristic burrows were often noted in the banks of arroyos and on sand flats. In a large colony on the sandy plain 3 miles northwest of Fruita, the entrances to the burrows were usually in large bunches of prickly pear (*Opuntia*), but were occasionally beneath bushes of *Atriplex confertifolia*. During the time this colony was under my observation, toward the end of September, the animals seemed inactive, and very few piles of fresh earth were noted at the burrows. No signs of kangaroo rats were seen in the Grand Valley above Grand Junction, and they probably do not occur east of Palisade, where the valley narrows into a more or less continuous canyon. They extend southeast in the Gunnison Valley for some distance, apparently reaching their eastern limit near Hotchkiss, on the North Gunnison River, where I collected an immature specimen in August. Burrows were often seen on the arid waste between Rogers Mesa and Delta, but none were noted in the Montrose region.

Kangaroo rats are reported abundant on the lower San Juan River, and they extend as far east as Moqui in the McElmo Valley. In June I found a few burrows on sandy flats along McElmo Creek at Ashbaugh's ranch, midway between Moqui and McElmo, but the animals were inactive here or else the burrows were deserted. Warren has taken the species at Ashbaugh's ranch.

Near Coventry, at 6,800 feet, scattered colonies of kangaroo rats are found in the rather hard clayey soil on the sagebrush flats, and the rats become increasingly numerous toward the west, as the elevation becomes lower, the soil sandy, and the region more desertlike. At Dry Creek, 5 miles west of Naturita, and thence down the East Paradox Valley and across the Dolores River to the head of West Paradox Valley, they are very numerous on the sandy flats and hummocks. On my return trip from the La Sal Mountains through the Sinbad Valley and thence down the Dolores River to the mouth of West Creek, however, no signs of kangaroo rats were seen, although much of the region is suitable for them. North of San Miguel River they are found at Nucla and nearly to Tabeguache Creek.

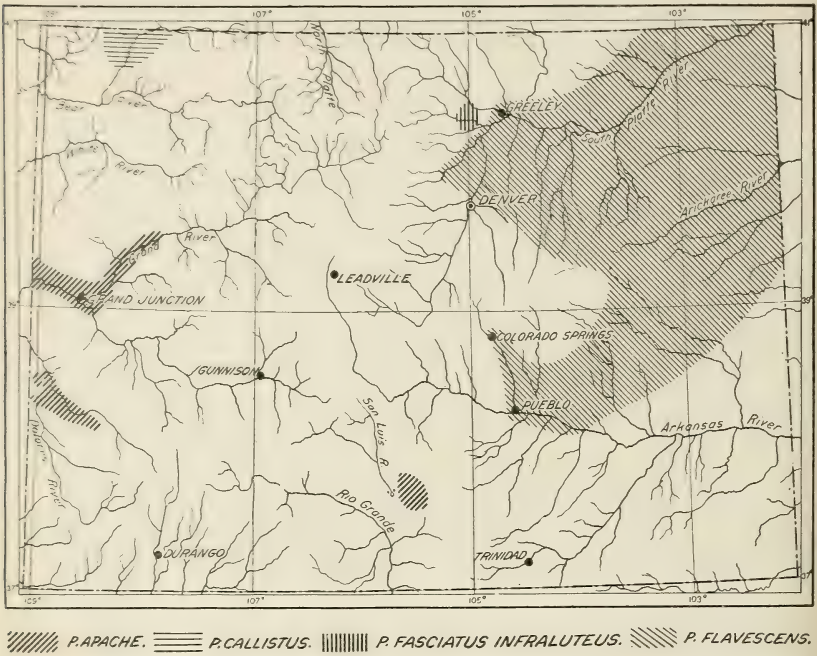
The burrows of this species average somewhat larger than those of *P. richardsoni*, although the animals themselves are of nearly the same size. The deserted burrows are often used by cottontails (*Sylvilagus a. warreni*) in the lower San Miguel region, and occasionally both animals are found living in the same colony.

Perognathus hispidus paradoxus Merriam. Kansas Pocket Mouse.

This large pocket mouse occurs sparingly on the plains of eastern Colorado, from the base of the foothills in Boulder and Jefferson Counties east and southeast to Baca County, in the extreme southeastern corner of the State. It has been taken at a few widely separated localities over this region in the Upper Sonoran zone.

Specimens were collected at Sterling by Dr. A. K. Fisher, who reports the species as tolerably common at that locality. Another was secured at Hugo by Prof. Lantz, who found it common along

Big Sandy Creek. In the Merriam collection there is a specimen from Boulder County, collected in 1889 by the late Denis Gale, of Gold Hill, at 5,500 feet. The precise locality is not given on the label, but was probably at the base of the foothills not far from Boulder. I noted several of the characteristic auger-hole burrows of this pocket mouse on the lowest foothill slopes a mile southwest of Golden, and found the species common in southern Prowers and Baca Counties. Specimens from Monon, Baca County, are recorded by Warren.[1]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San Luis R.
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Arkansas River
Dolores River
DURANGO
TRINIDAD
P. APACHE.
P. CALLISTUS.
P. FASCIATUS INFRALUTEUS.
P. FLAVESCENS.

FIG. 22.—Distribution in Colorado of pocket mice (*Perognathus fasciatus* and *P. apache* groups).

Perognathus fasciatus infraluteus Thomas. Buff-bellied Pocket Mouse.

Perognathus infraluteus Thomas, Ann. and Mag. Nat. Hist., ser. 6, XI, p. 406, May, 1893. Type from Loveland, Larimer County, Colorado.

Known only from the type locality, from which place the Biological Survey has a series of 10 specimens, collected in October, 1894, by Mr. Clark P. Streator. The type specimen in the British Museum was taken by Mr. W. G. Smith April 4, 1892. (See fig. 22.)

The Loveland animal appears to be geographically separated from its near relative, *P. fasciatus* of the northern plains, from which it is distinguishable by the strong buffy suffusion on the underparts in marked contrast to the pure white underparts of *P. fasciatus*.

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[1] Mammals of Colorado, p. 253, 1906.

Perognathus flavescens Merriam. Plains Pocket Mouse.

All the records for this pocket mouse are from the plains region north of the Arkansas Valley, where it appears to occur only in sandy strips of country, being most abundant in the northeastern counties. (See fig. 22.) It has not been taken in the southeast, where *P. flavus* replaces it. At Sterling Dr. A. K. Fisher found it common in sunflower patches on sandy soil, and Loring found it at Greeley occupying sandy strips of country with *P. flavus* and living in burrows beneath *Opuntia* and yuccas. Specimens were secured by Streator on the sandy bottoms along the Arkansas River at Pueblo in December, when the animals were gathering their winter's supply of seeds. At Tuttle I trapped a specimen beneath a yucca in a sand blow-out on the north side of the valley of the South Fork of the Republican River. A specimen from Boulder County was found by the late Mr. Denis Gale in the nest of a long-eared owl (*Asio wilsonianus*), at 5,500 feet, May 12, 1890. This record proves that the range of this pocket mouse extends at least to the eastern base of the foothills, and the animal may be found even in some of the warm foothill valleys. Warren has taken specimens at Colorado Springs, but thinks the species is uncommon at that point.

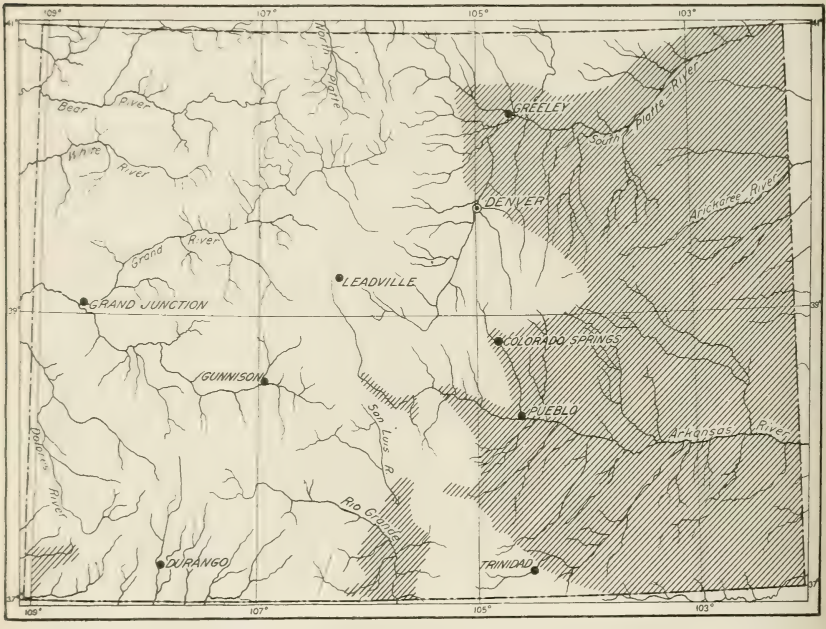
Perognathus flavus Baird. Baird Pocket Mouse.

This beautiful little pocket mouse is common on the Upper Sonoran plains of eastern and southern Colorado between 4,000 and 7,500 feet elevation, the highest altitude being reached in the San Luis Valley. (See fig. 23.) At a number of localities on the northeastern plains it is associated with *P. flavescens.* The burrows of the two species are not readily distinguished, but those of *flavus* average smaller. A large series from eastern plains localities are typical *flavus,* but specimens from Ashbaugh's ranch, Montezuma County, are considerably darker, and approach *P. f. bimaculatus.*

At Antonito and along the Conejos River, Bailey found this species abundant on the sandy sage plains, and I found it inhabiting similar areas at the Medano Springs ranch, near the San Luis Lakes, and also in weed patches and dry meadows. Most of the older gopher hills near the Medano ranch had been tunneled more or less by pocket mice, but I seldom found the burrows inhabited. These tunnels usually entered the soft dirt of the gopher hill from one side, passing horizontally through, and often connected with other horizontal tunnels. One such burrow was inhabited by an immature pocket mouse, which I caught in my hands. The hole reached a depth of 12 inches in the soft earth, ending in a small chamber 1 by 2 inches, in which were stored a few grass seeds. Although pocket mice are usually nocturnal, I caught one in a trap at the Medano ranch in the daytime, and also saw another individual running in the grass near the same burrow at 2 p. m. on a bright day. They appear to be inactive on damp or rainy nights.

At Ashbaugh's ranch two specimens were trapped beneath *Atriplex* bushes on sandy flats. Mr. Ashbaugh thinks this is the little pinkish mouse which does so much damage in the McElmo Valley at corn-planting time by enlarging the hole left by the corn planter and taking out the kernels; and also in the autumn, when it eats much grain beneath the shocks.

Near Greeley Loring found *P. flavus* abundant over a sandy strip of country, living among clumps of yucca and prickly pear. Streator collected a series of specimens in sunflower patches on waste land near Loveland in October, baiting his traps almost exclusively with sunflower seeds, which appeared to be the chief food of these mice at the time. Prof. Lantz found a large store of sunflower seeds in a burrow which he dug out in southeastern Otero County in April, 1910. He observes that the tail of this species is to some extent prehensile. In the case of several which he carried alive in his hand, the tail at times clasped a finger. In Shell Rock Canyon, northwestern Baca County, I usually found the burrows beneath tree cactus (*Opuntia arborescens*) in the sandy bed of the canyon or on the adjoining benches.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GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
DURANGO
TRINIDAD

FIG. 23.—Distribution in Colorado of Baird pocket mouse (*Perognathus flavus*).

There are specimens from Burlington, and Streator reported this species at Olney and Flagler. I saw numerous signs of small pocket mice at Gardner and Walsenburg among bunches of prickly pear (*Opuntia polyacantha*) on the sandy benches bordering the Huerfano and Cucharas Valleys. Warren has specimens from Colorado Springs, Lamar, Springfield, and Texas Creek between Rito and Hillside. A specimen in the collection of the Colorado Agricultural College, taken by Mr. S. Arthur Johnson in Spring Canyon, 4 miles southwest of Fort Collins, has been identified by the Biological Survey.

The distribution of *P. flavus* in the upper Arkansas Valley has not been worked out. It may occur in the sand as far up as Buena Vista, since it is common on the sandy slopes just above Salida. This region is doubtless reached by way of the Arkansas drainage area, although the Royal Gorge must prevent continuity of range in the immediate river valley.

Perognathus apache Merriam. Apache Pocket Mouse.

Eight specimens from Rifle, Fruita, Coventry, and Medano Springs ranch (San Luis Valley) are provisionally treated as *P. apache*, although none of them are quite typical. All are darker than typical *P. apache*, in this respect tending toward *P. a. melanotis*. The Coventry specimen in particular is very richly colored, like *melanotis*, but is larger, as are also three specimens from Bedrock, Montrose County, identified for Warren. It is probable that the Coventry and Bedrock specimens could be safely referred to *melanotis*, but, since dark, richly colored specimens are of irregular occurrence throughout the range of *apache*, it seems best to include all Colorado specimens under this species. (See fig. 22.) A specimen from the Grand River Valley near Rifle is very large for *apache*, but is equaled in size by one from Espanola, New Mexico. More material from southern and southwestern Colorado is needed before the status and distribution of the *apache* group of pocket mice within the State can be satisfactorily determined.

Little is known concerning the habits of these handsome, medium-sized pocket mice. In the lower Grand River Valley in 1906 I found them among the prickly pears on the sandy desert north of Fruita, and also on a sandy piece of waste land near Morris, 7 miles west of Rifle. A fair-sized colony was occupying a sandy knoll near Morris, and the many freshly ejected sand piles showed its members to be active. However, when I again visited the locality the following year, I noted very few signs. The distribution in the Grand Valley appears to be very local, as no signs of pocket mice were seen between Fruita and Rifle.

In the region of the lower San Miguel and Dolores Rivers the characteristic burrows of pocket mice were noted on a sandy sage flat near Uranium, in the Sinbad Valley. The extreme abundance of white-footed mice at this point prevented my taking specimens, but the large size of the sand heaps thrown out from the burrows pointed to *apache* rather than to the small *P. flavus*. As is usual with pocket mice, the entrances to the burrows were closed during the daytime.

In early November, specimens of *apache* were caught in traps set for harvest mice in a sandy weed patch on the Medano ranch, near the San Luis Lakes. They were taken beneath bushes of *Chrysothamnus patens*, but no burrows were found attributable to the species. One specimen got into a trap between 9 a. m. and 4 p. m. on a bright day. This individual evidently had been out foraging, as each of its cheek pouches contained nearly a thimbleful of the seeds of a honey plant (*Peritoma sonoræ*). These seeds numbered 164, and averaged about the size of No. 4 shot.

(?) **Perognathus callistus** Osgood. Red Desert Pocket Mouse.

While encamped on Snake River, southeast of Sunny Peak, Routt County, in August, 1906, numerous signs of a medium-sized pocket mouse were found on the first bench south of the river valley. Characteristic small heaps of dry earth had been recently ejected from most of the burrows, which were usually beneath bunches of prickly pear (*Opuntia polyacantha*). However, a large number of traps kept out for several nights failed to yield a specimen, owing chiefly to the abundance of white-footed mice, which were continually getting into the traps during the early evening hours. Signs of pocket mice were not observed elsewhere in northwestern Colorado, or at any point north of the Grand River Valley, although much of the region seems well suited to their needs.

The type locality of *P. callistus* is Kinney ranch, Wyoming, 40 miles northwest of Sunny Peak. The character of the country at both localities is similar, and it seems reasonable to treat the Snake River pocket mice as of this species. (See fig. 22.)

Zapus hudsonius campestris Preble. Prairie Jumping Mouse.

This Great Plains representative of the common northern jumping mouse enters Colorado along the South Platte Valley. (See fig. 24.) Thus far it has been found in this State only on the plains at the eastern base of the foothills. In July, 1895, Preble trapped two specimens in a dense growth of weeds along an irrigating ditch at Loveland. One in the Merriam collection was taken at Denver by A. W. Anthony, September 13, 1885. Warren says it is reported from Greeley by A. E. Beardsley.[1]

Zapus princeps Allen. Rocky Mountain Jumping Mouse.

Zapus princeps Allen, Bull. Am. Mus. Nat. Hist., V, p. 71, 1893. Type from Florida, La Plata County, Colorado.

In the Colorado mountains this large jumping mouse is chiefly an inhabitant of the Canadian zone, but it also follows down some of the streams into the Transition zone. It frequents the dense growth of

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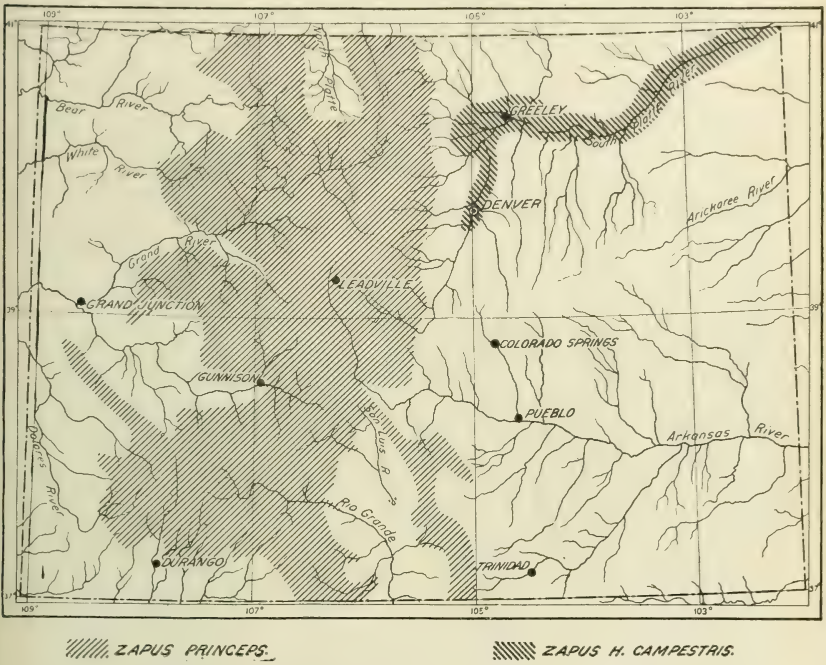
[1] Mammals of Colorado, p. 254, 1906.

Heracleum lanatum and other rank vegetation bordering cold mountain bogs and streams, but is also occasionally taken beneath logs in heavy forest. The species has a wide distribution in the mountainous parts (see fig. 24), but is nowhere abundant. Bailey says it is found in some of the marshes of the San Luis Valley. Near Del Norte he noted long lengths of grass stems which had recently been cut by jumping mice, while a specimen from east of Antonito was taken "in the grassy woods along the Conejos River, where most of the plants are Transition zone species which follow the river bottoms down into Upper Sonoran zone." Ranchmen near Meeker, Rio Blanco County, state that during the haying season jumping mice are often seen in the meadows bordering White River. The vertical distribution of this species is indicated by specimens from Meeker (6,000 feet) and Arapahoe Pass (over 9,000 feet).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Rio Grande
Dolores River
Durango
Trinidad
▨ ZAPUS PRINCEPS.
▨ ZAPUS H. CAMPESTRIS.

FIG. 24.—Distribution in Colorado of jumping mice (genus *Zapus*).

Erethizon epixanthum Brandt. Yellow-haired Porcupine.

Yellow-haired porcupines are more or less abundant throughout the mountains, but are most often seen in the coniferous forests of the Canadian zone. They occur regularly to timberline, and in the Grays Peak region are said to be found occasionally among the rocks far above the limit of trees. They are reported sparingly from the yellow pine belt of the eastern and southern foothills, and even extend down into the juniper and pinyon country in some of the southwestern counties.

Porcupines are reported to be common in the following localities: Middle and North Parks; Elk Head Mountains; White River Plateau; St. Elmo, Saguache Mountains; San Miguel Mountains; Lake City; San Juan Mountains, north of Pagosa Springs and Vallecito; La Plata Mountains, northeast of Mancos; and Culebra Mountains, near La Veta. I saw parts of a skin, but recently removed, at Highbridge, on Berthoud Pass, in October, 1906, and a dead porcupine was found in the trail east of Lake San Cristobal in the San Juan Mountains at 10,000 feet, while I have found quills in a mountain rat's nest near Mount Whiteley in northwestern Middle Park. In the foothills west of Antonito, Conejos County, Bailey saw numerous Douglas spruces and pinyons which had been partly divested of bark by porcupines, and also found a great many porcupine pellets in caverns beneath the broken lava rock; while farther north in the San Luis Valley two or three porcupines are said to have been killed by cowboys in the open valley on the Medano Springs ranch, near the San Luis Lakes.

The food of porcupines consists largely of the bark of coniferous trees, and the lodgepole pine seems to be preferred to firs and spruces. Occasionally such large areas of bark are gnawed from a tree that it dies. A porcupine was seen in an Engelmann spruce on Lone Cone, at an elevation of 11,000 feet, July 27, 1907, and I saw many spruces between 10,000 and 11,000 feet from which the bark had been partially stripped between 20 and 30 feet above the ground. Most of the yellow pines seen along the railroad in the valley a mile south of Vance Junction, San Miguel County, July 1, showed evidences of porcupine work in large sections divested of bark, on both the main trunks and the larger branches. The injury thus inflicted upon the coniferous forests throughout the mountains must be considerable. The animals feed to a small extent, at least, upon the aspen, since in 1905 I saw a number of these trees, both in the Rabbit Ear Mountains and on the White River Plateau, from which the bark had been gnawed at a height of 10 or 12 feet.

Owing to their sluggish movements, porcupines fall an easy prey to some of the larger predaceous mammals. On this point Warren remarks: "In spite of its protecting quills, it is eaten by coyotes, mountain lions, and bobcats, though possibly only in winter when other food is scarce, that being the only season when the writer has found remains of the animal so killed.[1]

Trippe records the porcupine as an inhabitant of Clear Creek County in the early days;[2] while Allen says it was common from foothills to timberline in Park County in 1871, and also reports it from the regions bordering the headwaters of the Arkansas and Del Norte [Rio Grande] Rivers.[1]

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[1] Mammals of Colorado, p. 254, 1906.

[2] See Coues, Birds of the Northwest, p. 225, 1874.

Ochotona saxatilis Bangs. Rock Cony; Pika.

Ochotona saxatilis Bangs, Proc. N. Eng. Zool. Club, I, p. 41, 1899. Type from near timberline, Snowy Range, Park County, Colorado.

The peculiar little rock cony is one of the characteristic mammals in the timberline region of the high mountain ranges. It is most abundant in the rock slides at or near timberline, but has been found also near the summits of the highest peaks, and on some of the western plateaus as low as 8,500 feet.

Conies are very abundant at 12,000 feet in the Grays Peak region and on Rollins Pass, and a little lower on Berthoud Pass. I heard of a small colony in slide rock near Arapahoe Pass, in the Rabbit Ear Mountains, at 9,000 feet. Frank Hayes, a taxidermist of Glenwood Springs, secured several specimens in rock slides near the head of Noname Creek, Garfield County, at an elevation of only 8,500 feet. Warren mentions seeing conies as low as 9,300 feet near Crested Butte.[2] They were reported from the San Juan Mountains, north of Pagosa Springs and Vallecito; La Plata Mountains, northeast of Mancos; Saguache Mountains, near St. Elmo; Lone Cone, San Miguel Mountains; and on the Sierra Blanca group. Prof. Lantz found them abundant on Pikes Peak between 12,000 and 13,500 feet.

The habits of conies are most interesting. As far as my observation goes, they live entirely in slide rock, usually on steep slopes, but near Silverton Loring found their characteristic haystacks in the crevices of lumber and slab piles near an abandoned sawmill; while Mr. D. Costello, of Gardner, tells of a cony which took up its abode beneath the floor of a cabin in the mountains north of Crested Butte.[3] The haystacks of these industrious little animals, comprising their winter food, are composed of many species of grasses and weeds, cut and gathered in summer, and allowed to dry among the rocks. Thistles are found in most of the stacks, and seem to be a favorite food. Well-worn runways lead from one stack to another and extend to neighboring rock slides. Conies are usually quite shy and would be seldom observed were it not for the odd, complaining notes which they utter continually when alarmed. The grayish color of the animal closely matches the dull-colored rocks in which it is found, and the notes often appear to come from a distant pile of rocks when in reality the motionless animal is within a few feet; or, again, the reverse may be true.

There are specimens from Mount Kelso; Longs Peak; Bald Mountain, 5 miles west of Ward; Sand Mountain, near Hahns Peak; Lake

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[1] Bull. Essex Inst., VI, pp. 57 and 66, 1874.

[2] Mammals of Colorado, p. 254, 1906.

[3] See under *Putorius streatori leptus*, p. 188.

City; Cumbres; and Silverton. The type and a large topotype series of *O. saxatilis* were collected by an expedition of the Museum of Comparative Zoology on the Snowy Range near Montgomery, Park County, in 1871. Mr. E. Thompson Seton has collected the species on Pagoda Peak, in eastern Rio Blanco County.

Lepus campestris Bachman. White-tailed Jack Rabbit.

This fine species is rather generally distributed over the eastern plains, except south of the Arkansas River, where it appears to be absent in some sections and sparingly present in others. It occurs also in considerable numbers in the mountain parks on the eastern slope of the mountains, to an elevation of 10,000 feet, but not west of the Continental Divide, being replaced there by the grayer form, *L. c. townsendi.* It is far more abundant in northern than in southern Colorado. At no point is it more numerous than in North Park, and in this region and the San Luis Valley I found it far more abundant than on the plains east of the mountains.

The white-tailed jack rabbits of the eastern plains are typical *L. campestris,* but those of the higher elevations are less yellowish and more grayish, showing an approach toward *townsendi.* This departure is well indicated in specimens from the immediate eastern slopes of the Continental Divide, as in the upper Arkansas Valley and in the northern and western parts of the San Luis Valley. Two females which Warren collected at 12,000 feet on the summit of Boreas Pass in early August are very gray, and are clearly referable to *townsendi;* while a male which I collected August 22 at Como, on the grassy South Park plains just below the eastern end of the Boreas Pass, at 9,800 feet, is nearest the *campestris* type.

In North Park white-tailed jack rabbits were very abundant in 1905. Early one morning in July, in a half hour's ride along Grizzly Creek near Hebron, I counted 19, most of which were feeding in alfalfa fields on the bottoms. Formerly jack rabbits were so numerous and so destructive to crops in the San Luis Valley that prize hunts were held each year and many thousands were killed. They are still found throughout the valley, but are common only in the sandy strip of country lying along the west base of the Sangre de Cristo Range. At the Medano Springs ranch, near the San Luis Lakes, I found them abundant in October, 1907, and shot six specimens among the *Sarcobatus* and *Chrysothamnus* bushes on the sand ridges. All of these, as well as others examined at the Medano ranch, had the upper central area of the tail heavily shaded with plumbeous, but the cowboys report that a lighter colored rabbit with the tail entirely white is occasionally killed in that region.

White-tailed jack rabbits are said to be not uncommon near Westcliffe, in the Wet Mountain Valley, and a few are reported near Bradford and La Veta, in western Huerfano County. One was collected December 5, 1907, in the dense yellow pine forest west of Eastonville. In some sections on the plains this species is becoming scarce of late years, and the numbers are rapidly decreasing throughout the plains region as the country becomes more settled. This is well illustrated by the fact that in May and June, 1909, I saw only one individual in the course of a wagon trip of over 300 miles, from Cheyenne Wells northwest to the Wyoming line, north of Grover. At certain localities *L. melanotis* appears to be replacing *campestris*. I saw a white-tailed jack rabbit just west of Fort Collins in 1906, and heard of a few at Wray, Yuma County, in December, 1907, although the predominant species at the last locality is *melanotis*. *L. campestris* was said in 1907 to occur very rarely along the east edge of Baca County, but I was unable to verify the report. In 1909 I saw one on the Arkansas Divide near Resolis. Among the eastern foothills of the Front Range it ranges as high as Estes Park and Gold Hill.

Allen found this species common in the parks of Park County in 1871,[1] while Trippe recorded it as common in Clear Creek County.[2]

Lepus campestris townsendi Bachman. Western White-tailed Jack Rabbit.

This is the western gray form of the white-tailed jack rabbit, and in Colorado, at least, is more an inhabitant of the mountains than its eastern relative. Though not unlike *L. campestris,* and scarcely distinguishable in the field, *L. townsendi* is much grayer, and a blackish or plumbeous area on the upper central part of the tail is almost always well indicated. It replaces *L. campestris* in the mountains west of the Continental Divide, and may occur regularly along its crest, since it has been taken at extreme timberline on Boreas Pass, at 12,000 feet. Specimens from just east of the Rocky Mountain watershed, in South Park and the upper Arkansas and San Luis Valleys, are best referred to *campestris,* though evidently intergrades.[3]

This rabbit occurs sparingly in the sagebrush country at Norwood and Coventry between 6,500 and 7,000 feet, but Mr. C. H. Smith says that at both localities it is outnumbered fully 10 to 1 by the black-tailed species *L. c. texianus.* During July, 1907, I saw only one at Coventry, but another was seen at the west base of Lone Cone, in the San Miguel Mountains, July 26. This was in a grassy opening among the dense oak chaparral at about 9,000 feet. Mr. J. P. Galloway, of Norwood, states that white-tailed jack rabbits are not uncommon on the lower slopes of Lone Cone. Tracks of jack rabbits were seen in the sandy, yellow pine country near the head of Dominguez Creek, on the Uncompahgre Plateau, at 8,500 feet, July 15. The form represented on this plateau is undoubtedly *L. townsendi*, as the region is too high for *texianus*.

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[1] Bull. Essex Inst., VI, p. 58, 1874.

[2] See Coues, Birds of the Northwest, p. 225, 1874.

[3] See Nelson, N. Am. Fauna No. 29, p. 81, 1909.

The white-tailed jack rabbits inhabiting the sage plains of western Routt County probably reach that region from the Wyoming plains on the north. As no specimens from that region are at hand, it can not be stated with certainty whether they are *townsendi* or *campestris*. From geographical considerations alone they might be referred equally well to either. In 1906 one was noted in the Snake River Valley west of Baggs Crossing, and tracks were noticed south of Sunny Peak. Another rabbit was seen at Douglas Spring at the northern base of the Escalante Hills, and the species was reported present throughout the Snake and Bear River region. Rabbits reported from the White River Valley above Meeker,[1] Egeria Park, and on the Gore Range, and others seen in Middle Park, can be referred without much question to *L. townsendi*.

Warren gives the following data regarding this form in the higher mountains: "Two females killed near Boreas Pass, in Summit County, each contained fœtuses, one four, the other five; one lot would probably have been born within a day or two, the other in about a week. This was on the 5th day of August. It seems very late in the season for young to be born at such high altitude, where winter sets in so early, one might say in mid-October frequently, and these rabbits are reported to live in these high regions the year round. Mr. H. L. Curtiss writes me he has seen them in winter on Fairview Mountain, near Pitkin, Gunnison County, at 12,000 feet."[2] Warren told me that the Boreas Pass specimens were jumped from beneath the dwarfed and matted Engelmann spruces at extreme timberline on Baldy Mountain, and that other hunters had found this rabbit in similar situations along the crest of the Front Range, where the animals obtain in the stunted and matted conifers protection from the icy winds which sweep the bleak and inhospitable summits. In the high mountain districts both *townsendi* and *campestris* assume a beautiful whitish winter coat, but do not become as white as the snowshoe rabbit (*L. bairdi*).

Lepus bairdi Hayden. Rocky Mountain Snowshoe Rabbit.

The large furry-footed snowshoe rabbits are found throughout the higher mountains from the lower edge of the Canadian zone at 8,500 feet to considerably above timberline. Along the lower edge of their range they meet the mountain cottontail rabbit (*Sylvilagus n. pinetis*), but above 9,000 or 9,500 feet *L. bairdi* is often the only rabbit present. I have seen very few of these rabbits on my trips through the mountains, but the tracks of their large furry feet and the well-worn trails in the snow which wind in and out of the dense willow copses in the gulches just below timberline show that considerable numbers are present in most sections.

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[1] Felger, Univ. of Colo. Studies, VII, p. 144, 1910.

[2] Further Notes on Mammals of Colo., p. 79, 1908.

Snowshoe rabbits are adepts at hiding in the cover of forest vegetation and easily escape notice. In the gloaming of an August evening one was discovered feeding in the willows which fringed a spring on the White River Plateau, 25 miles southeast of Meeker, at 8,500 feet, and it allowed a close approach before hopping unconcernedly into a denser thicket. Another got into a trap set under a cabin near Coulter, Middle Park, in the middle of October. The weather was cold and wintry, but this specimen had just begun to assume the white winter pelage on the legs and flanks. Lumbermen at Fraser, Middle Park, report snowshoe rabbits abundant, and often find them living under log piles and brush heaps. While following a logging trail near Fraser I discovered the remains of a rabbit which had been captured by a bobcat during the previous night. Bobcats and coyotes living in the higher mountains feed quite extensively upon this species, and on Berthoud Pass their tracks were often seen in the snow where they had been hunting rabbits among the willow copses near timberline. In June, 1905, rabbit signs were abundant among the alpine willows far above timberline on Mount Kelso, near Grays Peak. The species is said to be common in the forests of the Gore Range, east of Toponas; at Hahns Peak; in the San Juan Mountains, north of Pagosa Springs and Vallecito; on Lone Cone, San Miguel Mountains; and on Veta Pass. I found it very rare in the Saguache Mountains, near St. Elmo, Chaffee County. According to Preble it was tolerably common on Longs Peak in August, 1894, while Loring secured a fine series of 28 specimens at Silverton in the latter part of October, 1893. The majority of the Silverton specimens were collected in underbrush in the canyon, but a few were taken on the mountain sides near timberline. All were changing from brown summer pelage to the white winter coat, and Loring states that the white pelage was farthest advanced on individuals taken near timberline. Allen says snowshoe rabbits were reported as common in the timbered parts of Park County in 1871.[1]

Lepus californicus melanotis Mearns. Kansas Jack Rabbit.

Over the entire plains region of eastern Colorado black-tailed jack rabbits are found in varying abundance. (See fig. 25.) Formerly they were outnumbered by *L. campestris* in many sections on the northern plains, but the reverse is now true. They become increasingly numerous toward the south, where *campestris* is rare or absent. In Huerfano County, and doubtless elsewhere, they follow some of the widest valleys into the foothills, and may be found occasionally among the junipers and pinyons as high as 7,500 feet. The species seems to prefer open grassy plains to the foothill valleys grown up with *Atriplex* and *Chrysothamnus* and is most abundant at some distance from the mountains.

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[1] Bull. Essex Inst., VI, p. 58, 1874.

Although present in much smaller numbers than formerly, black-tailed jack rabbits are still sufficiently numerous in certain sections, particularly in the rich agricultural region lying along the Arkansas River, to injure seriously such crops as alfalfa, grains, cabbages, and sugar beets. In early days jack rabbits were extremely abundant in the Arkansas Valley, and for a number of years annual hunts were organized at Lamar to lessen the pest. Many thousand jack rabbits were sometimes killed in a single hunt.[1]

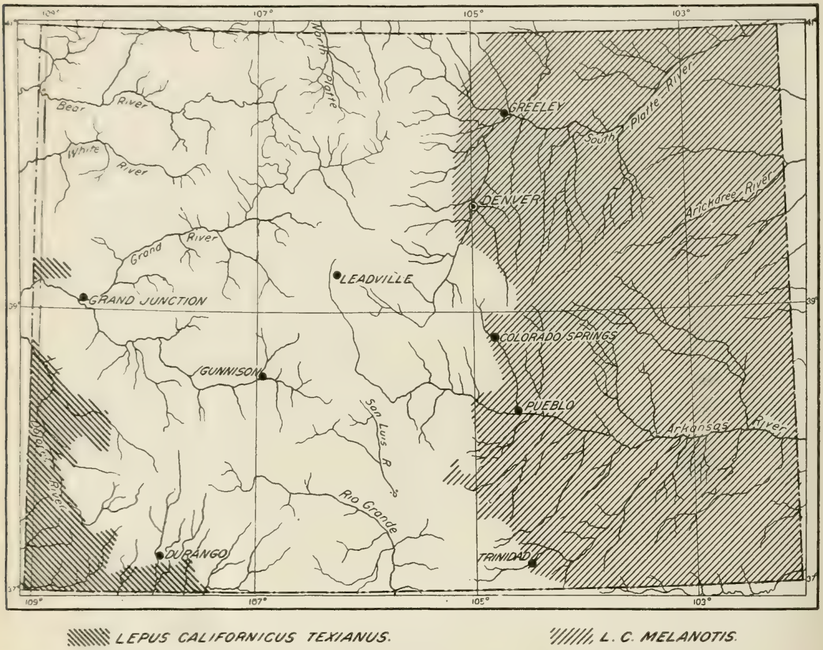
109°
107°
105°
103°
39°
37°
North Platte
Bear River
White River
Grand River
GRAND JUNCTION
LEADVILLE
GREELEY
South Platte River
DENVER
Arickaree River
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD
▨ LEPUS CALIFORNICUS TEXIANUS.
▨ L. C. MELANOTIS.

FIG. 25.—Distribution in Colorado of black-tailed jack rabbits (*Lepus californicus texianus* and *L. c. melanotis*).

In driving from Cheyenne Wells northwest across the plains to Cheyenne, Wyoming, in May and June, 1909, I found these jack rabbits common only in the sandy bunch grass country of Yuma County. Elsewhere they appeared to be greatly reduced in numbers. A very few were seen on the eastern end of the Arkansas Divide, and farther west at River Bend and Ramah, while two immature individuals were encountered near Pawnee Buttes, in northeastern Weld County. Prof. Lantz found them abundant in the Purgatory Valley south of La Junta in April, 1910.

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[1] For details of the Lamar rabbit hunts see Jack Rabbits of the United States, by T. S. Palmer, Bull. No. 8, Biological Survey, pp. 63–64, 1897.

Lepus californicus texianus Waterhouse. Texas Jack Rabbit.

The black-tailed jack rabbits inhabiting the Upper Sonoran desert valleys of western and southwestern Colorado (see fig. 25) are referable to the Texas form, although intermediate in coloration between *texianus* and *melanotis*.[1] In some sections they are abundant, in others very scarce, and their local abundance varies much from year to year, as in other parts of their range.

In the summer of 1907 I found jack rabbits common at Bayfield, La Plata County, and at Coventry, Montrose County. Small numbers were reported also on Mesa Verde, in McElmo Valley; near Mancos and Dolores in Montezuma County; and between Naturita and Paradox in western Montrose County. Early in June the rabbits were quite common along the lower edge of the pinyons and in the adjoining open sagebrush valleys and slopes southwest of Bayfield, at 6,500 feet. During the heat of the day they were usually resting quietly in the shade of the pinyons, but in the early morning and toward sundown could be seen actively moving about in the open, either nibbling at the short grass in the openings among the sagebrush or more often feeding in the grain and alfalfa fields. Several ranchmen southwest of Bayfield have small patches of grain in the openings along the lower edge of the pinyons, and these suffer most from the depredations of jack rabbits. One forenoon at 10 I surprised an entire family of rabbits eagerly feeding in one of these small isolated fields of young grain among the pinyons. This family, consisting of two adults and three or four young about two-thirds grown, had been levying heavy tribute upon the tender grain shoots, and the field was in a fair way to be entirely destroyed. A very little time and effort spent by the owner of this piece of grain in shooting jack rabbits would in all probability have saved it. Mr. E. G. Bates, of Bayfield, states that a diet of young alfalfa produces the same bloating effect on jack rabbits as on cattle and usually results fatally. No rabbits thus affected have come under my observation, unless it be in the case of a much bloated individual which I found lying dead in the sagebrush a short distance from a large alfalfa field near Coventry. In the Bayfield region jack rabbits are said to be very injurious to orchards in winter, when green food is scarce and the animals are forced to subsist by browsing and by eating the tender bark of young trees.

Black-tailed jack rabbits are not common in eastern Montezuma County, but toward the Utah boundary and thence west to the Abajo (Blue) Mountains in eastern Utah, their numbers are said to increase rapidly. I saw a single individual on a flat in the McElmo Canyon, near Moqui, June 22. North of the Montezuma Valley

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[1] See Nelson, N. Am. Fauna No. 29, p. 145, 1909.

texianus follows the pinyon and sagebrush country around the western ends of the Dolores and San Miguel Plateaus, chiefly west of the Dolores River, and reaches the San Miguel and Naturita Valleys through the Paradox Valley and Dry Creek Basin. It ranges eastward along San Miguel River to Coventry and Norwood and follows Naturita Creek nearly to its head at the northwest base of Lone Cone, where I saw one in a grassy opening in the oak chaparral at 8,500 feet, July 27, 1907. At the last three localities the range of this species overlaps that of the white-tailed *L. c. townsendi*, *texianus* being the common form in the lower elevations at Coventry and Norwood, and *townsendi* predominating up around the base of Lone Cone, in the Transition zone. I saw no jack rabbits while crossing the Paradox Valley on my way to the La Sal Mountains in July, but tracks were common in East Paradox Valley. Mr. C. H. Smith, of Coventry, reports them very injurious to growing grain, alfalfa, and vegetables, especially cabbages. Most of the cultivated land there is surrounded by a dense growth of sagebrush, which affords the rabbits effective concealment during the day and ample protection, as I can testify after several days of hunting with poor success.

A few black-tailed jack rabbits are reported in the desert areas of the lower Grand River Valley between Grand Junction and the Utah boundary. They are said to occur in small numbers near Douglas Spring, at the north base of the Escalante Hills, in western Routt County, but this report lacks verification. Mr. J. H. Gaut saw a black-tailed jack rabbit east of Antonito, in the Rio Grande Valley, in September, 1904, but as it was not secured its species can not be determined. On geographic grounds it should be *texianus*.

Sylvilagus floridanus similis Nelson. Nebraska Cottontail.

This small gray form of the small-eared *floridanus* group of cottontail rabbits comes into the State from the northeast, along the valleys of the South Platte and Republican Rivers and their tributaries, and ranges to the eastern base of the foothills, as indicated by the following localities at which specimens have been collected: Arvada, Jefferson County; Littleton; Barr; Orchard, Morgan County; Masters, Weld County; Dry Willow Creek, Yuma County; and Sterling. Mr. W. L. Burnett states that a specimen has been taken near Loveland.

Little is known of the habits of this cottontail in Colorado aside from the fact that most of the specimens have been taken in brushy thickets along watercourses, just as farther east. *S. a. baileyi* occurs on the plains on both sides of the Platte from the base of the foothills to the Nebraska line; so *similis* doubtless inhabits the wild plum thickets and the willow and cottonwood fringe along the river banks.

Cottontails were very scarce at Wray in December, 1907, but I saw a few tracks in the dense plum and hackberry thickets in the gulches south of Chief Creek, where *similis* should be found. A skull, however, found at a hole beneath a rocky ledge along one of the gulches had the characteristic large audital bullæ of *baileyi*. *S. similis* can be distinguished readily from *baileyi* by its much smaller and shorter ears and small audital bullæ. The only other Colorado cottontail which shares these characters is *S. pinetis*, a species restricted to the mountains. At Sterling, in June, 1909, I found this cottontail restricted to the immediate valley of the Platte, where one was occasionally jumped in the dense thickets of wild cherry and snowberry along the river. They were very wild, and the only one collected was a nursing female shot in an alfalfa meadow along the roadside June 2.

Sylvilagus nuttalli pinetis (Allen). Rocky Mountain Cottontail.

This is the cottontail of the mountain districts of Colorado, where it is generally distributed, mainly in the Transition zone. It is most abundant in the yellow pine forests of the eastern foothills of the front ranges, but is often found along the lower edge of the aspen belt. In the Pikes Peak region it occurs as high as 11,500 feet.[1] It is common on some of the pinyon-clad ridges and mesas of western Colorado as low as 6,000 feet along the upper edge of the Upper Sonoran zone; and has been taken on the higher sage plains of Routt County with *baileyi*. The favorite abode of the mountain cottontail is on the cool north slopes in the upper part of the pine belt, where it finds abundant cover in the creeping juniper (*Juniperus sibirica*) and in dense thickets of aspens, as well as in and among fallen logs. Ledges of rock and hollow logs are favorite retreats. This cottontail, like *grangeri*, belongs to the short-eared *nuttalli* group, and can not be easily confused with the long-eared cottontails, *baileyi* and *warreni*, of the surrounding Upper Sonoran plains and valleys. The rich dark winter pelage of *pinetis* is usually strongly tinged with vinaceous.

Sylvilagus nuttalli grangeri (Allen). Black Hills Cottontail.

E. W. Nelson, in his recently published monograph of the rabbits of North America,[2] refers to this form specimens of cottontails from the Escalante Hills and Lay, in western Routt County, and from Meeker. This is a northern member of the *nuttalli* group closely related to *pinetis*, with which it intergrades in southern Wyoming. *S. a. baileyi*, a member of the long-eared *auduboni* group, is also found over much of western Routt County. The cottontail rabbits of northwestern Colorado are not typical of any race, but appear to be intergrades—*grangeri*, *pinetis*, and possibly *baileyi*, being involved. A specimen I shot on the sage plains near Lay in August, 1905, seems to be intermediate between *baileyi* and *grangeri*. The cottontails of the northwestern sage plains thus present a most perplexing problem. To quote Mr. Nelson (l. c., p. 206): "One specimen in the Biological Survey collection (No. 139098) from Lay, Colorado, is indistinguishable in external characters from three specimens of *S. a. baileyi* from the same place, but its skull is that of *grangeri*, to which it has been referred. Several other specimens of cottontails, some *baileyi* and some *grangeri*, from northwestern Colorado are extremely puzzling, and much more material from there and elsewhere in this State is needed before the relationships and ranges of the several cottontails can be satisfactorily determined."

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[1] Warren, The Mammals of Colorado, p. 49, 1910.

[2] N. Am. Fauna No. 29, p. 207, 1909.

In the Escalante Hills I found the short-eared cottontails in small numbers at the edge of the yellow pines at about 7,000 feet, and others were seen down among the dense pinyon and juniper growth on the northern slopes.

Sylvilagus auduboni baileyi (Merriam). Plains Cottontail.

The common long-eared cottontails of the eastern plains of Colorado are *baileyi*, the only other form occurring there being the short-eared *similis*, which inhabits the brush patches and fringe along the South Platte and other streams of the northeastern counties. These two cottontails are quite unlike, and besides their structural differences have dissimilar habits. Thus *baileyi* inhabits the open grassy plains, where it lives in abandoned prairie dog and badger holes, or else takes up its abode in the rock ledges and bluffs bordering the valleys; while *similis*, so far as known, does not dwell in the open but in dense thickets along streams and in the bottoms of connecting gulches. The plains cottontail has a wide range from Montana south to the edge of the Llano Estacado of northern Texas. It occupies practically all the plains of Wyoming, extending south in northwestern Colorado on the sage plains and in the valleys of Routt and Rio Blanco Counties, where the high escarpment of the Book Cliffs and the White River Plateau separates it from *warreni* of the Grand Valley and southward. The range of *baileyi* meets that of the mountain cottontail (*S. pinetis*) at Meeker, Craig, and other points along the bases of the Elk Head Mountains and of the White River Plateau, as well as on the slopes of the higher divides between the river valleys. This species follows up the drainage of the Arkansas Valley to Salida, and probably occurs on the extensive Upper Sonoran flats farther up the valley, but in other sections is not known to penetrate the eastern foothills for any distance.

Throughout its range the plains cottontail is preeminently an inhabitant of the semiarid Upper Sonoran plains, where it lives in holes along the steep-cut banks of dry arroyos, in the deserted burrows of prairie dogs and badgers, and often in holes beneath sagebrush, *Atriplex*, or prickly pear (*Opuntia polyacantha*) on the open plain. In rough and broken regions, as along the Snake, Bear, and White Rivers, and in the juniper country of Baca and Las Animas Counties, it lives chiefly along the rocky rims of canyons.

In August, 1905, cottontails were abundant in the Bear River Valley south of Lay. In the evening and early morning, and often at midday, numbers usually fed on the small grassy flats between the river and the base of the bluffs. They were quite wild, despite their abundance, and when alarmed scampered up the arroyos and dry rocky slopes in all directions to their retreats in the ledges far above the river. Sometimes fully 20 individuals, adults and young, were in sight at once.

In traveling down the Snake River Valley in August, 1906, few cottontails were observed as compared with the great numbers seen on Bear River in 1905, and Mr. John Criss, of Baggs Crossing, Wyoming, informed me that a disease which he termed cholera had been thinning out their numbers very perceptibly throughout the region. In common with other rabbits *baileyi* is subject to a periodical disease, as yet very little understood, which invariably follows excessive abundance. This disease seems to be nature's check to abnormal increase, and did it not prevail, at least among the plains cottontails, much of the cattle range in the vicinity of streams and gulches would undoubtedly be ruined. As it is, the injury to the range is very considerable when the rabbits reach their maximum numbers, as on Bear River in 1905, and again on McElmo Creek and along the lower San Juan River in 1907, where *S. a. warreni* was so abundant that scarcely a spear of grass remained in the vicinity of the streams.

This species is fairly free from parasites and grubs and, except in the years when it is suffering from disease, is excellent food. On the sage plains of Routt County young cottontails were an important item on our bill of fare, and they were well-flavored and tender.

Sylvilagus auduboni warreni Nelson. Colorado Cottontail.

Sylvilagus auduboni warreni Nelson, Proc. Biol. Soc. Wash., XX, p. 83, July 22, 1907. Type from Coventry, Montrose County, Colorado.

This is the cottontail of the warm Upper Sonoran valleys and lowest mesas of southwestern Colorado south of Grand River Valley. The cottontails of the open plains of the San Luis Valley, although not typical, are referable to this form and, especially toward the northern end of the valley, approach *baileyi* in general paleness of coloration. The ranges of these two closely related forms appear to meet in this region, *warreni* doubtless extending around the southern end of the San Juan Mountains in New Mexico and then north into the San Luis Valley, while *baileyi* probably reaches the region from the south and east by following around the southern end of the Culebra Range. Under the circumstances it seems best to refer all of the San Luis Valley cottontails to *warreni*, since this type predominates. The northern boundary of the dispersion of *warreni* is marked by the White River and Book Plateaus, the cottontails found in the Grand Valley as far east as Rifle being fairly typical, while those occurring in the White River Valley from Meeker west are *baileyi*.

This form, like the other long-eared cottontails, is an inhabitant of sage plains, *Sarcobatus* valleys, and *Atriplex* flats, and is often found also among the rocks and pinyons. Cottontails were uncommon in the Grand Valley in both 1906 and 1907. Near Rifle, several were seen in the greasewood along arroyos and irrigation ditches, and north of Fruita, Mesa County, the rabbits were often started from their forms beneath *Atriplex confertifolia* on the open desert, or from the dense thickets of *Chrysothamnus* along the irrigation ditches. They invariably took refuge in the deserted burrows of badgers and white-tailed prairie dogs, in which apparently they were living. They were abundant at Hotchkiss in August, 1907, and one seen just east of Crawford, at the west base of the West Elk Mountains, was probably this form. At Coventry I found them abundant during July, both among the pinyons and out in the sagebrush, and collected several topotypes. On my trip to the La Sal Mountains they were seen in abundance in the Dry Creek and Paradox Valleys, but were scarce in Sinbad Valley and thence down the Dolores River to the mouth of West Creek. My camp assistant shot 11 young cottontails from the tent while cooking supper at our Dry Creek camp, 3 miles west of Naturita, July 19, and there seemed to be fully as many more among the rocks and sagebrush after his fusillade.

These rabbits were very abundant in the McElmo and San Juan Valleys in June, 1907, where they were reported quite injurious. Ranchmen stated that their numbers near Bluff City, Utah, were so great that nearly all the range grasses in the vicinity of canyons had been eaten by them before the middle of June. Mr. George J. Ashbaugh, who lives in the McElmo Canyon west of Moqui, says the cottontails are very injurious to his fruit trees during the winter. On the Mesa Verde these rabbits are scarce, only two being seen among the pinyons at 7,000 feet. They were fairly common at Bayfield, La Plata County, early in June, and a single individual noted in a willow copse along the San Juan River at Arboles may have been this form.

The type of this interesting cottontail, a female in winter pelage, measures: Total length, 375; tail vertebræ, 51; hind foot, 102; length of ear from notch, in dried skin, 70. It was collected at Coventry by Mr. C. H. Smith, January 4, 1907, and is in the Biological Survey collection. Regarding the characters of *warreni*, Nelson says (l. c.):

"Similar to *baileyi* in size, length of ears, and abundant pelage, but darker colored with more distinct gray rump patch and darker rufous on nape and legs." Its distribution is given as "southwestern Colorado and adjacent parts of Utah, New Mexico, and Arizona."

Felis oregonensis hippolestes Merriam. Cougar; Mountain Lion.

The mountain lion was formerly present over at least all the rough parts of the State, and in early times it was occasionally seen even well out on the plains along the more heavily brush-fringed streams. At present it is becoming rare east of the Continental Divide, although holding its own fairly well in the rough canyon and mesa country of the west and southwest. It is now most numerous in the pinyon country of Montezuma and Dolores Counties, and in western Rio Blanco and Routt Counties, the latter region being to-day perhaps the best lion country in the United States.

Probably *F. hippolestes* is the only form represented in Colorado, but a skin from Montezuma County, in the possession of Mr. Steve Elkins, of Mancos, is considerably paler and less reddish than lions from the Meeker region. Unfortunately there are no skulls or skins from extreme southwestern Colorado available for study. A series of 12 skulls from Meeker in the Biological Survey collection, collected by Mr. Theodore Roosevelt in January and February, 1901, have been referred to *F. hippolestes*.[1]

In some of the southern and western counties mountain lions are sufficiently numerous to be very destructive to stock, especially young colts. Near Lily Park, in western Routt County, calves also are said to be often killed by lions. Through Mr. James Lowell, of Dolores, a forest ranger, I learned that 16 colts had been killed by mountain lions in that region during the spring of 1907—11 in the yellow pine country between Plateau and Beaver Creeks, 20 miles north of Dolores, and 5 in the high aspen and spruce country on Bear Creek, an affluent of the Dolores River, about 20 miles east of Dolores. In addition to colts and calves, the lions prey much upon wandering bands of sheep in the yellow pine forests of Archuleta County.

Among game mammals deer appear to suffer most from mountain lions, and that they form the chief prey is evident from the fact that the lions move up into the mountains or down into the low country with the migration of the deer. Mr. E. E. Chapson, a forest ranger in the San Juan National Forest, thinks the lions and coyotes are the most important factors in the destruction of deer in the San Juan Mountains. The lion tracks seen in winter are almost invariably following deer trails, and, as the bodies of deer which have been killed by mountain lions are often found, Mr. Chapson thinks they kill many more deer than they require for food. Mr. Steve Elkins states that lions are very destructive to deer in the Montezuma National Forest. Mr. J. P. Galloway, of Norwood, relates that a lion, the track of which he followed several years ago on Wild Steer Mesa, south of East Paradox Valley, had dragged the carcass of a freshly killed deer to a secluded rocky place among the pinyons and left it covered with a pile of pinyon needles and cones fully 4 feet high. This habit of caching carcasses for future consumption has been noted by a number of Colorado hunters.

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[1] Proc. Wash. Acad. Sci., III, p. 586, 1901.

Mountain lions are much hunted with dogs in the regions of their greatest abundance, as in the Keystone country northwest of Meeker and in the Mancos region. When pursued by dogs, they are readily treed, usually after a short dash, seeking refuge among the upper branches of pinyons or junipers, where they are at the mercy of the hunters. The Meeker region has long been a famous lion country, and it was here that Roosevelt had his well-known hunt in the winter of 1901, bringing out a fine series of specimens, besides gathering important data on the habits of the species.

Although most abundant in the broken rocky pinyon and juniper country on the lower western slope of the Continental Divide, lions are nevertheless found occasionally above timberline. On the Saguache Mountains, 2 miles north of St. Elmo, I followed the track of a medium-sized lion through the snow for some distance, October 9, 1907. It was first crossed at 12,000 feet, and as far as followed, kept along the high wind-swept crests of the mountains above timberline.

Mountain lions were reported in varying numbers at the following localities in the northern mountains in 1905 and 1906:

Gore Range and mountains surrounding Middle Park: Small numbers reported.

Park Range (headwaters of Grand Encampment River): Reported by lumbermen as not at all uncommon. Tracks seen in the trail near the tie camps August 13, 1906.

Snake River region (Baggs Crossing to Escalante): Formerly common, but none remain. Mostly poisoned by professional wolf trappers some years ago, when there was a large bounty on wolves in this region.[1]

Browns Park: Fair numbers reported in mountains south of Green River, near Mount Cullom.

Escalante Hills: Three killed on south slope, 10 miles west of Lily, in the winter of 1905–6.

Lily Park: Reported common in surrounding pinyon country in winter.

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[1] This suggests that a liberal use of poison in a region where lions are troublesome would be the best means of reducing their numbers. Old trappers and wolf hunters state that lions readily eat of poisoned carcasses.

Rangely (lower White River): Not uncommon. Several killed each winter.

Book Plateau (near Baxter Pass): Reported as occasional in winter.

The following data on the abundance of lions in southern Colorado were secured in 1907:

Culebra Range (south of La Veta): Reported not uncommon in wilder parts, but none recently killed. One killed on Cucharas River several years ago.

Sangre de Cristo Range (Sierra Blanca group): Reported rare. Track seen on Sierra Blanca winter of 1906–7.

Sangre de Cristo Range (head Huerfano River): A few reported.

Cochetopa Hills (near Saguache): Said to be scarce.

Mancos region: Three killed by Mr. Steve Elkins during past year· I saw a young lion's track in Navajo Canyon, on the Mesa Verde, June 13.

Sierra el Late: A few reported around Ute Peak.

Lower San Miguel and Dolores Rivers: Becoming scarce.

Lone Cone (San Miguel Mountains): Has never been common.

Coventry: Scarce. Several have been killed along the San Miguel River, but none recently.

Uncompahgre Plateau: Rare.

Vallecito: Occasionally met with.

Over much of the eastern slope mountain lions are very rare, where they were formerly common. Allen says, regarding its former presence in Park County: "Not uncommon. Its cry was once heard near our camp at Montgomery."[1] Trippe[2] records it as an early inhabitant of Clear Creek County. It was reported from Estes Park during the early nineties of last century. Coues mentions two mounted specimens in the collection of Colorado mammals exhibited at the Philadelphia Exposition in 1876 by Mrs. M. A. Maxwell, stating that "one was killed near Boulder by poisoning the carcass of a young horse which the panther had destroyed."[3]

Lynx canadensis Kerr. Canada Lynx.

The Canada lynx inhabits the Canadian zone forests of the higher mountains in Colorado, but in most sections its numbers are rapidly decreasing. The scattering records at hand indicate a former general distribution over the central and northern mountainous parts of the State, while a few are still left in the San Juan and La Plata Mountains of the southwest. At present the animal occurs chiefly in the heavy forests of the Park and Gore Ranges, the Rabbit Ear and Vasquez Mountains, and in southern Pitkin and Eagle Counties. It is said seldom to wander below 8,000 feet,[4] even in the heaviest snows of winter.

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[1] Bull. Essex Inst., VI, p. 53, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

[3] Dartt, On the Plains and Among the Peaks, p. 218, 1879.

[4] A lynx reported to have been killed at Bayfield (6,500 feet) is an exception.

In 1905 lynxes were reported to be tolerably common in the mountains surrounding Middle Park. Alpert & Co., of Kremmling, purchased several skins taken in the winter of 1904–5 in the Williams Mountains, near the headwaters of the Williams Fork of Grand River; and Mr. Fred Selak, a fur buyer living near Coulter, annually handles a small number of skins from both the Grand Lake region and the Rabbit Ear Mountains. Lynxes are said to leave the higher mountains in February and March and come down into the forested country of the Grand Lake region, following the downward movement of the grouse and ptarmigan. The North Park slope of the Rabbit Ear Mountains is very good lynx country, and Mr. W. H. Graham, of Spicer, informed me that he and his brother usually trap from 10 to 15 each winter near the head of Arapahoe Creek. On the Medicine Bow Range and in the lodgepole pine forests east of the Laramie River lynxes are said to be uncommon. A few are reported by lumbermen on the Park Range along the headwaters of the Grand Encampment River, but little trapping appears to be done in that section. Dr. Kerneghan, of Steamboat Springs, has three fine lynx skins which were taken on the west slope of the Park Range during recent years, and states that in the winter of 1904–5 he saw tracks of a lynx in the aspen thickets on a mountain 2 miles south of Steamboat Springs at about 7,500 feet. Mr. J. R. Carron, storekeeper at Columbine, near Hahns Peak, usually buys two or three skins each year, but in 1906 none were brought in. A lynx taken in the Elk Head Mountains in the winter of 1905–6 was sold to Mr. Robert McIntosh, of Slater. According to Mr. A. G. Wallahan, a few are still found in the Williams River Mountains. Mr. Dall DeWeese, of Canon City, has a mounted specimen from the South Fork of White River, where he says lynxes were not at all uncommon some years ago. Mr. Frank Hayes, a taxidermist of Glenwood Springs, states that in the winter of 1903–4 he saw a lynx track at Mud Springs, on White River Plateau, and in 1905 purchased five skins which had been taken the preceding winter near Mount Jackson, at the northern end of the Saguache Range. While located at Aspen just previous to 1900, Mr. Hayes purchased six or eight lynx skins each winter, taken in the three following regions: Italian Mountain and Taylor Park, which are on the headwaters of Taylor River; region about Snow Mass Peak; and Independence Pass, at the head of the Roaring Fork of Grand River.

A very few lynxes were reported in 1907 in the mountains north of Pagosa Springs, and Mr. Don C. Coulson, of Bayfield, has handled a few skins from the high country in the Vallecito region, and also one skin which was taken in the winter of 1905 on a ranch adjoining the town of Bayfield (6,500 feet). Mounted specimens seen at Silverton and Ouray were doubtless killed in the neighboring mountains, but I could learn nothing definite concerning their history. Apparently this lynx is more numerous in the La Plata Mountains than in the San Juans. Mr. Steve Elkins, of Mancos, has trapped several in the spruce belt, and states that his hounds occasionally tree one while following a bear trail. This species is known as the snowshoe lynx in the La Plata Mountains.

A winter skin from Grand Lake, in northeastern Middle Park, is in the Biological Survey collection.

On the occurrence of *Lynx canadensis* in Park County, Allen says: "Represented as common. Saw skins of this species in the possession of hunters, taken in the vicinity of Mount Lincoln."[1] Warren mentions a skin which Mr. C. E. Aiken, of Colorado Springs, received from Beulah, and which is supposed to have come from either the Wet Mountains or the Sangre de Cristo Range.[2]

Lynx baileyi Merriam. Plateau Wildcat.

The bobcats of the lower parts of southern and eastern Colorado are referable to *L. baileyi*. The few Colorado specimens at hand do not permit an accurate outline of the distribution, but this wildcat appears to be most abundant in the Upper Sonoran zone. Along the eastern slope the species ranges a short distance into the foothills, and in the southwest is found commonly over an extensive area of rocky pinyon and juniper country. Bobcats are rare or entirely absent over much of the plains region east of the mountains, where the brush fringe and the few rocky ledges and bluffs along some of the streams furnish the only suitable environment. A few have been killed in the rocky canyons along Chief Creek, near Wray, Yuma County, during recent years, and in May, 1909, I saw tracks of a bobcat among the sandstone ledges near Tuttle, on the South Fork of Republican River. The animals have never been common in the Chimney Cliffs, northwest of Sterling, according to residents. The extensive juniper country in western Baca, Las Animas, and southern Otero and Bent Counties, however, is an ideal habitat, and bobcats are abundant throughout that region. They are reported common in the lower foothills from Fort Collins and Arkins south to Gardner, La Veta, and Trinidad, and in the southwest I have seen tracks at Arboles, Bayfield, on the Mesa Verde, near McElmo, East Paradox Valley, Sinbad Valley, south of Grand Valley, Plateau Creek, and on the desert north of Mack, lower Grand River Valley.[3] Bobcats reported from the cottonwood-fringed streams along the east side of the San Luis Valley are probably *baileyi*, as a specimen has been taken on Conejos River at the southern end of the valley.

Bobcats prey much upon rabbits, wood rats, and other small cliff-dwelling mammals, and in the open valleys sometimes subsist to a large extent upon prairie dogs and pocket gophers. Locally they are probably to be considered useful animals, the balance in their favor being due to the destruction of so many noxious rodents. On the other hand, wherever poultry is within reach they commit serious depredations, and near Pagosa Springs they are said to be very destructive to sheep.

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[1] Bull. Essex Inst., VI, p. 53, 1874.

[2] Mammals of Colorado, p. 258, 1906.

[3] Some of the above notes may refer to *L. uinta*.

Lynx uinta Merriam. Mountain Wildcat.

Although represented by specimens chiefly from the northwestern part of the State, this appears to be the species of the higher foothills and mountains generally, where it replaces *baileyi* of the lower foothills and canyons. It is a more robust animal than *baileyi*, with the cranium proportionally larger, and in size approaches *L. canadensis*, with which species it occurs at some of the higher elevations.

Bobcats are abundant in the rough pinyon and juniper country of Routt, Rio Blanco, and Garfield Counties. In 1906 the greatest numbers were reported northwest of Meeker and west of Snake River between Baggs Crossing and Escalante. Dogs are often used in hunting bobcats in the Meeker region, as the animals are readily treed after a short run. A series of skulls from near Meeker was collected by Mr. Theodore Roosevelt in 1901 and added to the Biological Survey collection.

Cottontails and snowshoe rabbits probably form most of the food of this species. Just below timberline in the Saguache Mountains near St. Elmo, and in other localities ranging between 10,000 and 11,000 feet elevation, I have followed the tracks of bobcats in the snow as they crossed and recrossed the dense willow copses in the trails of snowshoe rabbits, which they had evidently been hunting. In the lower part of its range, as in western Routt County, prairie dogs are next in importance on the summer bill of fare.

While walking along the railroad track near Rogers Mesa, in the North Gunnison Valley, in October, 1907, I had an excellent opportunity to watch the method by which the bobcat hunts prairie dogs. I was just emerging from a deep cut when I saw a large reddish bobcat at a distance of not over 40 feet. It was sneaking through the scattering greasewood bushes flat upon its belly, its short tail twitching nervously, and the excited chattering of prairie dogs on a neighboring flat showed that its approach had been noted by the alert animals. One large old prairie dog in particular, apparently the cat's intended victim, was seated at its burrow on the edge of the town, chattering in a bantering manner and appearing less frightened than the rest. The burrow was within leaping distance (about 10 feet) of the edge of the greasewood, and in making its approach the cat took advantage of every bush, stopping in the cover of each for a few moments. When it reached the last bush and was gathering itself for the final leap, the old prairie dog disappeared, but only just in time, as in another moment the cat landed on the rim of the burrow. Rapid, nervous jerks of the tail showed the cat's disappointment as it glared about in different directions. Up to this time my presence had not been noted, and not until I had thrown several stones did the cat see me, whereupon it bounded away across the dog town in long leaps. The section men working along the railroad stated that they often saw a cat near this colony, and it doubtless had its den in the neighboring rock ledges along the North Gunnison River, living easily on the fat denizens of the town.

On September 7, 1906, I saw two bobcats in the *Sarcobatus* brush along Snake River, a mile north of Lily, and tracks were often seen in the dry sandy beds of arroyos in the valleys of northwestern Colorado.

Canis occidentalis Richardson. Gray Wolf.

Gray wolves were formerly abundant over practically the entire State, except possibly the highest mountains, and were especially numerous on the eastern plains, where large bands preyed upon the buffalo. From this habit of hanging on the flanks of the large herds, they were generally known as buffalo wolves. The mountain animals are said to average much darker than those of the plains. Unfortunately there are no specimens available from the mountains to settle this point, but it is unlikely that two forms occur in the State. Wolves are still found in considerable numbers in North Park and in Routt and Rio Blanco Counties, where they kill a great many range cattle. A few are probably found throughout the mountains west of the main ranges, and small numbers are still present over the more unsettled parts of the eastern plains region, particularly in Baca and eastern Las Animas Counties, in the extreme southeast, where, in 1907 and in 1910, they were said to be common and to kill a great many sheep.

In 1906 wolves were common over most of Routt County, notwithstanding the bounty of $15 authorized by the local stock association, the additional $10 offered by the county, and the efforts of several professional wolf trappers employed by the association. The heaviest losses of stock were at that time incurred on the Iron Springs Divide and south of the Elk Head Mountains, although wolves were reported as unusually abundant in Browns Park on Green River. In the latter region the stock association hired three or four trappers to reduce their numbers, and about fifty were killed during the winter of 1905–6, the majority being trapped. Mr. John Criss, a trapper of many years' experience in the Snake River country, informed me that the wolves have been so persistently hunted, trapped, and poisoned that they will now rarely come to a scent of any description and seldom to a baited trap, while poisoning is unsuccessful. He has had the best success with traps set blind and placed in trails or near water holes in the badland country, several miles back from the Snake River Valley. A method of fastening wolf traps, used successfully by Mr. Criss in cold weather, seems worthy of mention. The trap is securely chained to a bush or stake at the edge of a steep-walled gully or wash so that the wolf in its struggles to escape will leap over the edge and hang half suspended and helpless, unable to regain the top of the bank. Wolves thus trapped in severe weather usually freeze to death in a few hours.

An impression prevails among stockmen in northwestern Colorado that wolves retire to the mountains to whelp, but I find no evidence to support this theory.[1] In Dixon, Wyoming, I saw a nearly adult black wolf in captivity, which had been captured as a cub in a den among the Snake River bluffs, 20 miles west of Baggs Crossing, in the spring of 1905. This individual was kept in a large cage in the back yard of its owner in Dixon. A boy of 3 years was petting and stroking its head through the bars, and the wolf's every movement betokened its pleasure in the companionship of the little fellow. All playfulness immediately left it, however, on the approach of a man, when the wild, untamable wolf nature was revealed in bared fangs, curling lips, and glaring eyes. The mother of this wolf was gray, as was also one of the three cubs captured in the den. According to trappers both black and white wolves occur, but white ones are said to be extremely rare.

In the Lily Park region, on the lower Bear River, Mr. F. C. Barnes states that wolves were numerous until 1902, but during the two years following a trapper named Snyder killed 61. Since that time few cattle have been killed in that section by wolves. In 1905 wolves were reported in considerable numbers in the White River country, particularly in the valley of the Piceance, but were scarce near Rangely in 1906. During the winter of 1904–5, 7 were killed out of a band of nearly 25 which was ranging in North Park, but in 1906 wolves were reported scarce in that region. I often saw wolf tracks in the trail as we traveled through the parks on the divide east of the Laramie River, in August, 1906, and the animals were then said to be very troublesome in that section. Tracks were observed as high as 10,000 feet. Wolves are of rare occurrence in Middle Park, but two are said to have been seen on the stage road near Coulter during the winter of 1903–4, and another near Grand Lake the following winter. One of a band of three which ranged on the head of Willow Creek, in the northern part of Middle Park, was killed early in the summer of 1906. In Egeria Park and on the Gore Range wolves are reported as of rare occurrence. They were uncommon over most of southern Colorado in 1907, particularly in the San Luis Valley, the Pagosa Springs region, and in Montezuma County, where they are considered very rare. According to Mr. Steve Elkins, of Mancos, none have been reported in that region since the winter of 1904–5, when four or five were seen between Cortez and Mancos. In the region contiguous to the upper waters of the Vallecito and Los Pinos, in northeastern La Plata County, they are said to be increasing during the past few years, but no serious damage is reported. Forest Supervisor E. W. Shaw, of Durango, states that a band of 12 was seen near Vallecito in the winter of 1906–7. A few wolves were reported from the western part of San Miguel and Montrose Counties, a large male having been killed in the Dry Creek Basin in the winter of 1906–7, and a female with four whelps was stated to be ranging the same region in the summer of 1907. According to Warren, wolves were reported in the fall of 1906 to be increasing on the Black Mesa, south of the West Elk Mountains.[1]

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[1] On this point, see Bailey, Wolves in Relation to Stock, Game, and the National Forest Reserves, Bull. 72, U. S. Forest Service, 1907.

Dr. A. K. Fisher reported wolves as common near Las Animas in 1892 and in the Estes Park region in 1894, and according to Streator, numbers were to be found the same year on the Republican River, north of Burlington, and in the vicinity of Olney. Prof. Lantz reports that a band of three was often seen in the vicinity of Hugo during the winter of 1904–5. The rough canyon country of Las Animas, Baca, and southern Otero and Bent Counties was in early days resorted to by large numbers of wolves for breeding purposes, and many still breed in that region.

Ranchmen living in northwestern Logan and northeastern Weld Counties stated in the summer of 1909 that wolves were very scarce in that section, only one being known to inhabit the Horsetail Basin south of the Chimney Cliffs. This is said to be a female, and is supposed to be the mother of eight whelps which were dug out of a den in the rough country on the head of Deadman Creek, 20 miles northeast of Avalo, in the spring of 1909. In the spring of 1908 a litter of six or seven was dug out in the same canyon, two of which were taken alive to Nebraska, and another one was kept on a ranch north of Sterling until it became vicious, when it was killed. In 1908 a cowboy named Frank Jordan is stated to have roped an old male wolf on the open plains in the same vicinity.

Allen states that "*Canis lupus*" was comparatively scarce in Park County in 1871, although formerly abundant there.[2] As "*Cani occidentalis*" Trippe records the wolf as an early inhabitant of Clear Creek County.[3]

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[1] Further Notes on Mammals of Colorado, p. 82, 1908.

[2] Bull. Essex Inst., VI, p. 54, 1874.

[3] See Coues, Birds of the Northwest, p. 224, 1874.

Canis lestes Merriam. Mountain Coyote.

This large, dark, richly colored species occurs more or less abundantly throughout the mountains, ranging from the lower foothills to above timberline. Its habits are not unlike those of the coyotes of the plains and valleys, but its prey is somewhat different, consisting chiefly of dusky grouse, cottontails (*Sylvilagus n. pinetis*), and snowshoe rabbits, and including also many deer and fawns. A small band of these coyotes hunting together has even been known to kill several mountain sheep which had been shut into a small pocket by an avalanche.[1] Fawns are of course preyed upon in summer and early fall, but the adult deer only in winter when the crust will sustain the coyotes but not the deer. I am informed by forest rangers who have seen coyotes pursuing deer in this manner that a band of five or six will overtake a deer and hamstring it very quickly on a weak crust of snow. Many calves also are killed by coyotes in the mountain parks, and in certain localities it is almost impossible to raise chickens and turkeys because of their depredations.

At the Medano Springs ranch, in the San Luis Valley, coyotes were unusually abundant and destructive in October, 1907. Numbers were seen each morning on the broad hay meadows west and north of the ranch buildings, where they mixed freely with the cattle, and evinced little fear of man unless he carried a gun. Several were noted lying quietly on the tops of haystacks, from which they could detect anyone approaching. During the day one was in almost every extensive weed patch or growth of rank marsh grass, ready to pick up the turkeys and chickens which strayed too far from the ranch buildings. On the meadows near Saguache coyotes have been seen catching meadow mice and playing with them like a cat. In the yellow pine forests of Archuleta County coyotes are very destructive to sheep, notwithstanding the night fires kept burning by the Mexican herders.

On the Saguache Mountains near St. Elmo I saw many fresh coyote tracks in the snow above 11,000 feet, October 9, 1907. One track followed a high ridge above timberline, at 12,500 feet. I have noted tracks also on the summit of Berthoud Pass, and coyotes are commonly reported on Grays Peak and in other sections of the high mountains.

Canis nebracensis Merriam. Plains Coyote.

The coyotes of the eastern plains region are referable to *C. nebracensis*, the type of which is from Johnstown, Nebraska, and specimens from the sage plains of North Park and Routt County seem nearest this species. This light-colored coyote inhabits the lower levels, being replaced in the higher foothills and mountains by *C. lestes*, a much darker animal.

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[1] See note under *Ovis canadensis*, p. 64.

On my trips through the northern parts of the State I found coyotes most numerous on the extensive sage plains bordering the Snake and Bear Rivers, in Routt County, although they are abundant in North Park and at many points east of the mountains, especially in the Wray region and northwest of Sterling. Wherever found in any numbers in settled districts, coyotes kill a great many sheep, young calves and pigs, and much poultry. They are heartily hated by stockmen and farmers alike, who never lose an opportunity to kill them. The stock association in Routt County was offering a bounty of $1 on coyotes in 1906, but most of the professional wolf trappers claimed that this was not sufficient remuneration, and hence coyotes were increasing rapidly at that time. A few trappers, however, were at work on coyotes in the Snake River region in 1906. Mr. John Criss, of Baggs Crossing, Wyoming, who makes his winter headquarters near Sunny Peak, is said to trap and poison about 200 coyotes each winter. While I was traveling down the Snake River Valley coyotes were numerous and bold, and were heard at all hours of the day and night.

Coyotes partly compensate for the damage to live stock and poultry by catching great numbers of noxious rodents, such as pocket gophers, prairie dogs, ground squirrels, rabbits, and mice—particularly meadow mice, of which they appear very fond. One noted in a hay meadow near Lake John in the western part of North Park, August 9, was so busy hunting for meadow mice in the rank grass that it appeared oblivious of the presence of eight teams at work in the field and did not become alarmed until my companion shot at it.

Mr. W. O. Potter, of Avalo, states that once on the plains of northeastern Weld County he saw an eagle flying heavily with a captured prairie dog, and under the eagle a coyote following along with the apparent intention of pouncing on the quarry when the eagle became wearied and alighted to eat it.

Canis estor Merriam. San Juan Coyote.

Doubtless all the coyotes inhabiting the warm Upper Sonoran deserts and valleys of southwestern Colorado should be referred to *C. estor,* which was described from Noland's ranch, San Juan River, Utah. The Book Cliffs appear to separate this small pale desert species from *C. nebracensis* of the Routt County sage plains.

Coyotes are abundant near Mancos, on the Mesa Verde, in the McElmo Valley, in the region of the lower San Miguel and Dolores Rivers, and in the lower Grand Valley. The chief damage appears to be to sheep and poultry, although in the McElmo Valley they are said to eat a great many watermelons and cantaloupes on the vines. A coyote seen near McElmo June 20 was small and light-colored, and in all the lower valleys the small pale coyotes are distinguished locally from the large dark animals of the mountains.

Vulpes macrourus Baird. Western Fox.

This species, which is larger and darker than the eastern red fox (*V. fulvus*), is common in the Colorado mountains. It is subject to a wide range of color variation, covering the red, cross, silver-gray, and very rarely the black phase. The proportion of dark individuals is much greater than with *fulvus*. This fox is found at the present time chiefly in the forest belt of the higher mountains, above 8,000 feet. Its distribution in this region is general, and in some sections considerable numbers are present. I have no data respecting its range on the plains in early days, but, judging from its former occurrence on the plains of Nebraska and Wyoming, it was probably present sparingly over eastern Colorado. In the canyon country in parts of southwestern Colorado this fox is fairly common as low as 6,000 feet. The species yields a fur of considerable value and is extensively trapped in winter.

In 1905–6 it was reported as tolerably common in the Rabbit Ear, Williams and Williams River Mountains, on the Front, Park, and Medicine Bow Ranges, and on the White River Plateau. Small numbers were reported on the Gore Range and in the mountains around Mount Cullom and Zenobia Peak, in western Routt County. The red or tawny phase appears to predominate in the Elk Head Mountains, since in a series of 17 skins handled by Mr. Robert McIntosh, of Slater, in 1906, 15 were red and only 2 were of the cross phase. Mr. L. Wallace, of Granby, Middle Park, states that the majority of skins taken in the Grand Lake region are cross foxes. According to Warren, four out of six foxes killed near Crested Butte, Gunnison County, were of the cross phase.[1] Foxes were reported in small numbers in the mountains of Clear Creek County in 1905. At the Stevens Mill, on Mount McClellan, I learned of a young fox which had been captured in the spring by Italian miners on Grays Peak, at about 12,000 feet, and kept in confinement for a time. Skins which Loring saw at Grand Junction in 1893 probably came from the Grand Mesa region, and during the same year he reported foxes from Estes Park.

In the southern and southwestern mountains this fox appears to have fully as wide a distribution as father north. In the San Juan Mountains north of Pagosa Springs and Vallecito the cross phase is most common, according to the best-informed hunters and trappers. There are a few silver-grays, and very rarely a black fox is seen. Cross foxes are said to predominate also in the Saguache Mountains near St. Elmo, and a black fox has been seen near Tin Cup. Foxes are reported in small numbers from the Cochetopa Hills, La Plata Mountains, near Lone Cone in the San Miguel Mountains, and the Uncompahgre Plateau. Mr. Case, a trapper, is said to have taken

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[1] Mammals of Colorado, p. 259, 1906.

19 foxes along the Dolores River Canyon between the mouths of Disappointment and Paradox Creeks during the winter of 1906 7. Of these, several were cross foxes, while 2 were graded by the furrier as silver-cross and brought $50 apiece. The western canyon country seems to be especially frequented by foxes, although the altitude is low. Both silver-gray and red foxes are reported sparingly from the mountains on each side of the Wet Mountain Valley, and a black fox is said to have been seen at the eastern base of the Sangre de Cristo Range, west of Westcliffe, many years ago. Mr. E. W. Scott, of La Veta, has seen a fox skin from Veta Pass, and several silver foxes are stated to have been trapped on Sierra Blanca during recent years.

At Ward, Boulder County, in June, 1893, Loring found a fox den among the rocks on a mountain side, and collected the female, whose fur was badly worn, and four half-grown young. Scattered around this den was a varied assortment of bones (including a fish bone), chicken wings, bird feathers, and a pair of old buckskin gloves. Each time the den was approached, the old fox barked and ran away a few rods in an attempt to lure the intruder from its vicinity.

Allen states that in a series of 40 winter skins which he examined at Montgomery, Park County, in 1871, nearly half were cross and one individual was black.[1] The only published color description of the black phase of *V. macrourus* relating to a Colorado specimen appears to be that given by Coues and Yarrow of a melanistic skin from Los Pinos (now Bayfield), La Plata County, as follows:[2]

"A specimen, which we are inclined to refer to this species on account of its great size and especially large tail, is jet black all over, with a pure white tip to the tail; one of the finest examples of complete melanism we have seen. The purity of the black is only interrupted by a slight gray grizzle on the face and rump."

Warren has published the description of a dark silver skin from Cumbres Pass, Conejos County, in the Colorado Museum of Natural History.[3] Coues says there were many specimens of this fox in Mrs. M. A. Maxwell's mounted collection of Colorado mammals which was on exhibition in Washington during the winter of 1876–77.[4]

Vulpes velox (Say). Kit Fox; Swift.

[*Canis*] *velox* Say, Long's Exped. to Rocky Mts., I, p. 487, 1823. Type from South Platte River (in Logan County?), Colorado.

The small swift or kit fox was formerly common over the plains of eastern Colorado, but has become rare in most sections. In 1892 Dr. A. K. Fisher says it was reported tolerably common in the vicinity of Sterling (near type locality), and Mr. Edward A. Preble states that it was considered very rare in the region about Loveland in 1895. On the plains of Boulder County very few, if any, remain at the present time. The only record for this region in recent years appears to be that of two which were killed on the farm of Mr. Samuel Hays, 3 miles northeast of Boulder, in 1903. Mr. W. H. Graham, of Spicer, says he has met with this fox but once during a long residence in North Park. In 1893 he shot two near their den, which was on an open sandy slope near Arapahoe Creek, in the southern part of the park. Prof. Lantz found a dead swift on the prairie near Cheyenne Wells in 1903, and was informed that they were not uncommon in that region. In 1907 swifts were reported as common on the plains of Baca County and also in southern Bent and Prowers Counties. In all probability they are now more common in southeastern Colorado than elsewhere in the State. A few were reported in 1909 on the eastern end of the Arkansas Divide and near Tuttle on the South Fork of the Republican River. There is said to be a colony of them near Keota, southwest of Pawnee Buttes, in northeastern Weld County.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Expl. W. of 100th Mer., V, p. 55, 1875.

[3] The Mammals of Colorado, p. 238, 1910.

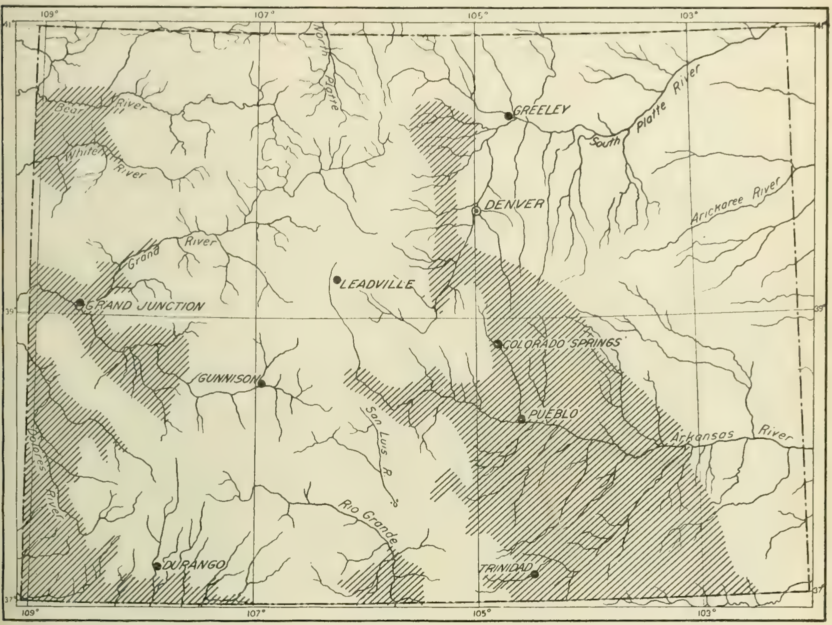
[4] Dartt, On the Plains and Among the Peaks, p. 219, 1879.

Urocyon cinereoargenteus scotti Mearns. Gray Fox.

The range of the gray fox in Colorado is in the juniper and pinyon foothills on both sides of the mountains, chiefly in the Upper Sonoran zone. On the east side of the mountains it is known from Loveland and the Estes Park region, the foothills from the Arkansas Valley southward, and the rough country of Las Animas, southern Bent, and western Baca Counties. (See fig. 26.) It is more common in the rough pinyon country of western and especially of southwestern Colorado, where it ranges north sparingly to the Escalante Hills in western Routt County. Specimens examined from both sides of the mountains are referable to this form.

Most of my notes are from west of the mountains. Mr. A. G. Wallahan, of Lay, reports seeing two skins of gray foxes in Lily Park in March, 1905, and Mr. F. C. Barnes, of Lily, killed one near there the following winter. Members of a railroad surveying party working in the Yampa Canyon of Bear River during the winter of 1904–5 are reported to have killed several gray foxes. In the Escalante Hills, north of Bear River, as well as in the southwestern counties, the animal is known as the pinyon fox. Ranchmen report an occasional gray fox at Rangely, in the White River Valley, and also at Mack, in the lower Grand River Valley. A few are said to have been killed near Rifle during the past few years, and at Grand Junction in 1893 Loring saw the skin of one which had been killed in Mesa County.

The gray fox reaches its greatest abundance in the region from Montezuma County north to the San Miguel River. Mr. Steve Elkins states that in the Mancos region they are usually found in the pinyon belt, but occasionally also among the yellow pines at the west base of La Plata Mountains. He often hunts foxes with dogs and kills a good many in this manner. A ranchman living on McElmo Creek, in western Montezuma County, is said to have caught 15 gray foxes in one winter. I found a den near McElmo in June, 1907, which had apparently just been vacated by a family of foxes. It was in loose shaly earth near the summit of a bare hill in plain view of a house and near a traveled road. There were a number of entrances to this den several rods apart, and the ranchman living near by stated that he often saw the old fox and three young ones frisking about during the day. This fox is reported as common in the pinyon country bordering the lower San Miguel and Dolores Rivers, and Mr. C. H. Smith, of Coventry, traps a number each winter along the Naturita Canyon just back of his ranch. In the Uncompahgre Valley near Montrose these foxes are termed swifts. A mounted specimen which I saw at Montrose was killed within 3 miles of that point and a number of skins and rugs seen in stores there indicate that gray foxes are common in that section.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41
39
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Bear River
White River
North Platte
GREELEY
South Platte River
DENVER
Arickaree River
Grand River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Dolores River
Rio Grande
DURANGO
TRINIDAD

FIG. 26.—Distribution in Colorado of gray fox (*Urocyon c. scotti*).

Mr. J. W. Frey, of Salida, has a mounted specimen taken in that vicinity and says a number have been killed in the pinyon hills bordering the upper Arkansas Valley during recent years. In Huerfano County gray foxes are found in the pinyon country at both Gardner and La Veta, and Mr. E. W. Scott, of La Veta, has a mounted specimen from the upper Cucharas Valley. A mounted specimen seen at Buffalo, Jefferson County, was probably killed in the neighboring hills. In 1904 Bailey reported a few gray foxes among the lava buttes east of Antonito, in the southern end of the San Luis Valley, but I could learn of none in the northern and central part of the valley in 1907. Loring saw two gray foxes among the rocks in Estes Park in 1893 and shot one of them.

Mephitis hudsonica Richardson. Northern Plains Skunk.

This species, the largest of the Colorado skunks, comes into the State from the north and inhabits chiefly the higher mountainous sections. It is not known to occur south of Colorado Springs and Salida. Unfortunately the specimens examined represent very few localities, and therefore the distribution can not be accurately given. At Arkins, Larimer County, judging from a large series of skulls, *M. hudsonica* and the long-tailed skunk of the plains, *M. m. varians*, occur in about equal abundance, apparently without intergradation.[1] The ranges of the two species may overlap over a considerable area along the lower eastern foothills, since Warren has taken both at Colorado Springs. A series ot 19 skulls from Arkins and 1 skull from Spicer, North Park, in the Biological Survey collection, are referable to *hudsonica*. Specimens in the Warren collection from Colorado Springs and Salida are doubtfully referred to this species, although they are by no means typical.

All the records of skunks secured in the mountains of northern and central Colorado are tentatively referred to *hudsonica*. In 1905 and 1906 I noted tracks near Coulter, on Grand River above Kremmling, and along the upper Snake River at Honnold. A den was found among the rocks on the north slope of the Elk Head Mountains, southeast of Slater, and the remains of a skunk were seen at Hayden, on the upper Bear River. Skunks were reported in Middle, North, and Egeria Parks, and in the vicinity of Meeker and Glenwood Springs. In 1893 Loring found skunks common in Estes Park, where they were said to kill much poultry.

Allen found skunks common in Park County in 1871, and says they range above timberline in that section.[2]

Mephitis mesomelas varians Gray. Long-tailed Skunk.

The long-tailed skunk is found on the eastern plains, and also enters the State from the south in the Rio Grande Valley. It occurs at a few points along the edge of the foothills with *M. hudsonica*, as already stated, but over the lower eastern part of the State appears to be the only large skunk present. The skunks reported at Bradford, Gardner, and La Veta, in the foothills of Huerfano County, and also along the pinyon-clad foothills bordering the San Luis Valley, are doubtless *M. varians*. This species can be readily distinguished from *M. hudsonica* by its smaller size, relatively longer tail, and by the usual absence of the pencil of white hairs at the tip of the tail.

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[1] See Howell, N. Am. Fauna No. 20, p. 25, 1901.

[2] Bull. Essex Inst., VI, p. 54, 1874.

In addition to a large series of odd skulls and several skins from Arkins, Larimer County, the Biological Survey has specimens of *varians* taken at Loveland, Sterling, Canon City, Chivington, and Antonito. The Merriam collection contains a female from Boulder County. Howell records a specimen from Conrow (Chaffee County), and two from Costilla County.[1] A skull in the National Museum from Cripple Creek may have been taken in the low Oil Creek Valley west of that point, as *varians* is not known to occur at the higher elevations or much above the upper edge of the Upper Sonoran zone. Specimens from Colorado Springs and from Gaume's ranch and Springfield, Baca County, have been identified by the Biological Survey for Warren, and he has recently recorded the species from Wray, Yuma County.[2]

The food of skunks consists chiefly of insects and the smaller rodents. Near Higbee, Otero County, Prof. Lantz found them feeding extensively upon the larvæ of tiger beetles (*Cicindela*), which they dug out of the sand on the banks of Purgatory River.

Mephitis mesomelas estor Merriam. Arizona Skunk.

The large skunks reported in the warm southwestern valleys, from Grand River southward, are probably *M. m. estor*, since three specimens from the pinyon country around Coventry are referable to this form. Although very generally reported, the large skunks appear to be less common in most sections of the southwest than the small spotted species (*Spilogale*). Tracks of skunks were seen along Plateau Creek, near Tunnel, Mesa County; in the mud along McElmo Creek, Montezuma County; and along an irrigation ditch at Nucla, western Montrose County. Loring saw the tracks of a skunk at Silverton.

The distribution and relationships of the skunks of western Colorado are imperfectly known, and additional specimens from many localities in this region are greatly desired. It is not likely that *estor* occurs north of the Book Cliffs. The skunks of the Routt County sage plains are probably *M. hudsonica*, but there are no specimens at hand from that region.

Spilogale interrupta (Rafinesque). Prairie Spotted Skunk.

This handsome dark species of spotted skunk ranges a short distance into the central eastern part of the plains region of Colorado, the only Colorado specimen known being one taken at Wray, Yuma County, by Warren, and identified by the Biological Survey. While at Wray in December, 1907, I was informed that small numbers of spotted skunks frequented the sandstone bluffs along the south side of the Chief Creek Valley.

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[1] N. Am. Fauna No. 20, p. 32, 1901.

[2] Further Notes on Mammals of Colorado, p. 83, 1908.

Prof. Lantz states that spotted skunks are reported common in the vicinity of Hugo, Lincoln County. The specific identity of the Hugo animal is uncertain, since there are no specimens available from that section, and since *S. tenuis*, the species found along the eastern foothills, probably ranges a short distance out on the plains in the region of the Arkansas Divide. The prairie spotted skunk may be distinguished from the other forms occurring in the State, *S. tenuis* and *S. g. saxatilis*, by its larger size and darker coloration, the white spots and bars being at a minimum. The tail also is usually wholly black except the white tip.

Spilogale tenuis Howell. Rocky Mountain Spotted Skunk.

Spilogale tenuis Howell, Proc. Biol. Soc. Wash., XV, p. 241, Dec. 16, 1902. Type from Arkins, Larimer County, Colorado.

Little is known regarding the range of this species, all the information at hand indicating a scattering distribution in both the Transition and Upper Sonoran zones among the lower foothills at the eastern base of the mountains. Most of the records are from north of the Arkansas Divide, in Larimer, Boulder, Jefferson, and Douglas Counties. It has been collected in northeastern New Mexico, however, and no doubt ranges across the entire width of Colorado along the eastern foothills.

In June, 1905, I saw the tracks in a dry gulch a mile or two southwest of Golden, while at Arkins (the type locality) the animals were reported tolerably common in the valleys below 6,000 feet. Mr. Berry, a ranchman, is said to have killed one a mile southwest of Arkins in July, 1906. Mr. Vernon Bailey caught one among the rocks in the foothills 2 miles west of Boulder in October, 1903, but it escaped. Several specimens have been collected at Boulder by Mr. R. T. Young.[1] Warren records a specimen from Sedalia, Douglas County, in the collection of Colorado College,[2] and has an immature specimen from Colorado Springs in his own collection. A specimen from Estes Park is in the American Museum of Natural History, and one from Loveland is in the National Museum.

In 1907 I was informed by Mr. William King, of the Medano Springs ranch, near the San Luis Lakes, that he has seen a number of spotted skunks among the foothills on the San Luis Valley side of the Sangre de Cristo Range, near Mosca Pass. The species may have crossed the mountains through this low pass, as it is reported present in the Muddy and Huerfano Valleys, on the east side of the range. In the rough juniper country of Las Animas and western Baca Counties, in the extreme southeast, spotted skunks are reported much more common than *Mephitis*.

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[1] Proc. Acad. Nat. Sci. Phila., p. 406, 1908.

[2] Further Notes on Mammals of Colorado, p. 83, 1908.

Spilogale gracilis saxatilis Merriam. Great Basin Spotted Skunk.

The small spotted skunks of the warm Upper Sonoran valleys west of the Continental Divide are referable to *saxatilis*, although specimens from Coventry, in western Montrose County, are not typical. Over most of their range *Mephitis* occurs with them but in smaller numbers. The spotted skunks are much more active and agile than the large ones and readily climb pinyons and junipers. Rock ledges along canyons are much frequented by them.

None were collected in northwestern Colorado during 1905 and 1906, but they were reported as occurring in all the valleys entering the State from the west. According to Mr. John Criss, a wolf trapper with headquarters at Baggs Crossing, Wyoming, the spotted skunk is tolerably common on the lower Snake River, where it is the only skunk present. It occasionally gets into his wolf traps in winter, and he has trapped it as far east as the old Edwards sheep camp, 35 miles below Baggs Crossing. Spotted skunks are reported common at Escalante, Routt County; and in Lily Park, at the confluence of the Snake and Bear Rivers, ranchmen often find them beneath houses and in cellars. At Rangely, in the valley of White River, they are said greatly to outnumber the large striped skunks. They are reported also from the upper White River country, according to Felger.[1] The range of *saxatilis* probably extends in the Grand Valley as far east as Glenwood Springs. I occasionally heard of it west of Rifle, Garfield County, and Mr. Fred Baker, a taxidermist of Glenwood Springs, reports that he has handled several skins taken during the past few years in the Grand Valley east of Newcastle.

In 1907 spotted skunks were reported as common and greatly outnumbering *Mephitis* in the Mancos and McElmo Valleys (Montezuma County), in the region of the lower Dolores and San Miguel Rivers, and at Coventry. A few were reported also in the vicinity of Bayfield, La Plata County. At Ashbaugh's ranch, in the McElmo Canyon, a female got into a small trap which I had baited with a piece of potato and set among the rocks for wood rats. Mr. C. H. Smith has caught a number of these skunks in the pinyons back of his ranch at Coventry, one being taken in a tree trap set for gray foxes 3 feet up on the trunk of a large pinyon standing on the upper rim of Naturita Canyon. A male in the Biological Survey collection was taken by Howell among rocks 2 miles south of Grand Junction.

Taxidea taxus (Schreber). Badger.

The badger is one of the most widely distributed mammals in the State, occurring throughout the plains and deserts of the lower parts, and in the mountains ranging with more or less regularity nearly to timberline. Two forms may be present, there being a possibility of

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[1] Univ. of Colo. Studies, VII, No. 2, p. 145, 1910.

T. berlandieri in extreme southern and southwestern Colorado, but this can not be determined from the scanty material now available.

The numerous holes which badgers are continually digging on the plains in search of their rodent prey make horseback riding in certain sections somewhat hazardous. Aside from this, however, badgers are most beneficial mammals, since their food consists chiefly of prairie dogs, ground squirrels, and other noxious rodents, which they secure by digging down to the nests. On the sage plains and in the mountain parks of northwestern Colorado the badger feeds extensively upon the white-tailed prairie dog (*Cynomys leucurus*), the Wyoming ground squirrel (*Citellus elegans*), and pocket gophers (*Thomomys*). Badgers are voracious, and one animal will open up a large number of burrows in a night.

In 1905 and 1906 badgers were abundant in Middle, North, and Egeria Parks and in the valleys of the Bear, Snake, Green, White, Grand, and Eagle Rivers. A specimen shot among the White River bluffs, 20 miles east of Meeker, was running up the steep side of a canyon. One was found dead in the trail near the head of Grand Encampment River, on the Park Range, at an elevation of 10,000 feet. Warren mentions that he killed a specimen in Gunnison County at about 11,500 feet.[1] In 1907 badgers were reported common in southern and southwestern Colorado, where they prey largely upon prairie dogs (*Cynomys gunnisoni*). Loring secured a specimen near Cochetopa Pass, and Bailey reports them common in the Rio Grande Valley near Antonito. The burrows are common on the South Park plains east of Como, at 9,800 feet. Other members of the Biological Survey have found badgers common at Sterling, Loveland, Estes Park, Las Animas, Burlington, and Olney.

Lutra canadensis (Schreber). Otter.

Otters seem to have been always rare in the State, although the reason is not apparent. The country is well watered, and nearly all the lakes and streams are well stocked with fish and should offer a satisfactory habitat. My notes refer for the most part to western Colorado, and the otter of that region may be the southwestern form described by Rhoads as *L. canadensis sonora*. This can not be confirmed at present, as there are no specimens available.

During the winter of 1902–3 four otters were trapped on Snake River within a few miles of Slater, Routt County, by two trappers, Messrs. James Coates and James Parsons, living at Slater. In 1905 Mr. A. G. Wallahan, of Lay, Routt County, reported a few still present in the Yampa Canyon on Bear River.

Warren thinks the rarity of otters in mountain streams may be due to the "freezing of their sources of supply" in winter.[2] There are, however, many fine lakes throughout the mountains well stocked with fish and furnishing a most favorable environment for otters. The following records are given by Warren (l. c.): "Grand Junction and Big Dolores River, a few (Dr. E. F. Eldredge); Platte River, east of Greeley, one specimen (A. E. Beardsley); Julesburg, occasional (H. G. Smith)." In a more recent publication Warren gives the following data: "Mr. Henry Lehman, of Grand Lake, tells me there are a few otter in the Grand River, in Grand County. Herman W. Nash writes me that friends of his saw two in the Gunnison River, near Sapinero, in August last.[1] Felger records this species from the White River Valley on the authority of Ball.[2] Trippe records the otter from Clear Creek County;[3] and Coues mentions a specimen from Boulder County, which he saw in the collection of Mrs. M. A. Maxwell.[4] A skull in the National Museum is from Pueblo.

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[1] Mammals of Colorado, p. 261, 1906.

[2] Ibid, p. 265, 1906.

Lutreola vison energumenos (Bangs). Mink.

Minks occur in varying abundance on nearly all the larger streams of Colorado, and in the unsettled parts the skins bring considerable revenue to trappers. They are more abundant in the mountains than on the plains, and are especially common in Middle and North Parks, where their fondness for poultry makes chicken raising most unsatisfactory on many ranches near streams. The minks of the higher mountains yield a rich dark fur of good quality, but the plains animal is said to be considerably paler and consequently less valuable. As no specimens of minks from the eastern part of the plains region are at hand, it is not certain that they are of the same form as the mountain animal, but specimens from along the eastern base of the foothills are identical with those from the higher mountains.

A female which I collected on Boulder Creek, 5 miles west of Boulder, in June, is very dark, the fur being full and heavy, even at that late date. Other dark minks were observed on McIntyre Creek, Larimer County, and in the Elk Head Mountains, during August, and I saw two rich dark skins from the upper Los Piños in a store at Bayfield. Mink tracks were observed on Snake River, at Honnold; on Bear River, at Hayden and Lily; on White River, at Meeker and Rangely; on Grand River, at Glenwood Springs, Kremmling, and Hot Sulphur; on Plateau Creek, near Tunnel; on Good Spring Creek, near Axial; and on Green River, near Ladore. Minks were reported abundant on the Cucharas River at La Veta and on the San Juan River at Pagosa Springs. Specimens from Loveland, Cochetopa Pass, Pagosa Springs, and Arkins (Larimer

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[1] Further notes on Mammals of Colorado, p. 84, 1908.

[2] Univ. of Colo. Studies, VII, No. 2, p. 146, 1910.

[3] See Coues, Birds of the Northwest, p. 224, 1874.

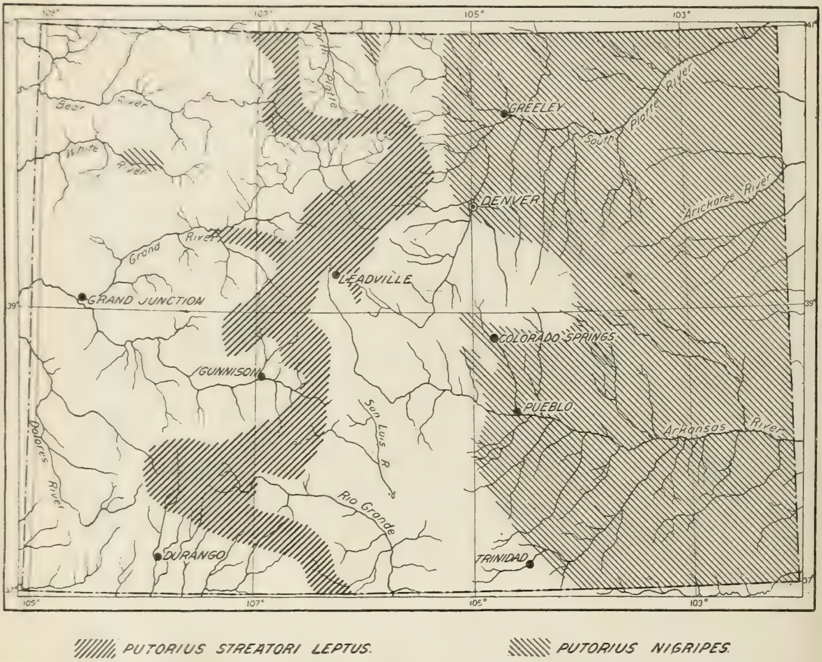
[4] Fur-bearing Animals, p. 312 (footnote), 1877.

County) are in the Biological Survey collection. Others in the Warren collection from Crested Butte and Colorado Springs have been examined by the Biological Survey.

In 1871 Allen found minks common along the streams of Park County as high as 10,000 feet.[1]

Putorius nigripes Aud. and Bach. Black-footed Ferret.

This rare and little known mammal has been recorded from a number of localities on the plains of eastern Colorado (see fig. 27), but here, as elsewhere over its range, its numbers are small. Usually it is found in prairie-dog towns, where it takes up its abode in an abandoned burrow, and from this convenient base preys upon the defenseless inhabitants of the colony. These ferrets are most beneficial mammals, because their prey consists largely of prairie dogs.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White River
North Platte
Grand River
GREELEY
South Platte River
DENVER
Arickaree River
LEADVILLE
GRAND JUNCTION
39°
39
COLORADO SPRINGS
GUNNISON
PUEBLO
San Luis R.
Arkansas River
Dolores River
Rio Grande
DURANGO
TRINIDAD
37
▨ PUTORIUS STREATORI LEPTUS.
▨ PUTORIUS NIGRIPES.

FIG. 27.—Distribution in Colorado of dwarf weasel (*Putorius streatori leptus*) and black-footed ferret (*P. nigripes*).

In December, 1894, black-footed ferrets were reported to Streator as present, but rare, at three points in the Arkansas Valley: Olney, Otero County; Arlington; and Chivington, Kiowa County. Prof. D. E. Lantz heard of a very few in the region about Hugo in 1905, where they are known as prairie-dog ferrets. In 1907 I heard of this species in the dog towns of Baca and southern Prowers Counties, and it seems to be more generally known in that region than in other sections on the plains. I did not hear of ferrets in the prairie-dog country of northwestern Colorado, but Warren records two mounted specimens at Meeker, said to have been taken near there, and mentions a specimen from the Laramie River, 12 miles south of the Wyoming boundary, in the University Museum at Boulder.[1]

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[1] Bull. Essex Inst., VI, p. 54, 1874.

Two specimens in the Warren collection indicate a most remarkable vertical range for this plains mammal. Warren says: "One specimen in my collection came from Divide, Teller County, at an elevation of 9,800 feet, another was found dead in Lake Moraine, El Paso County, altitude 10,250 feet. It is a mystery how the animal came there, and when skinned there were no marks on its body to indicate the cause of death. In the spring of 1904 C. E. Aiken mounted one which came from near Clyde Station, El Paso County, altitude 9,440 feet." [2]

Others have been recorded by Coues,[3] as follows: A specimen taken in the Cache la Poudre Valley by Dr. Law and brought to Washington by Dr. Hayden; another reported by Dr. Hayden as having been kept in confinement at Greeley for a considerable period; and two or three specimens procured by Mrs. M. A Maxwell in the vicinity of Denver and forming a part of her exhibit of Colorado mammals at the Philadelphia Exposition. All the above ferrets were taken in prairie-dog towns, and one of Mrs. Maxwell's specimens had been drowned out of a prairie-dog hole and captured alive. This individual was kept in confinement for some time. "It became quite tame, readily submitting to be handled, though it was furious when first caught. It was kept in a wire cage and fed on beef. When irritated it hissed and spat like an angry cat. It used to hide by covering itself over with the material of which its nest was composed, but at times, especially at night, it was very active and restless." [4]

Putorius longicauda (Bonaparte). Long-tailed Weasel.

The large long-tailed weasel of the plains should be present over practically all of the State east of the mountains, but until thorough collecting is done there, its abundance and distribution can not be indicated. It is not known from the mountains of Colorado. Weasels from the lower edge of the foothills are referable to the slightly smaller *P. arizonensis*, so it is quite probable that *P. longicauda* is restricted to the plains well out from the mountains. It probably occurs over a considerable area in western Routt County, since a male in the Warren collection from the sage plains at Lay, examined by the Biological Survey, is referable to this species. Another Colorado specimen of *P. longicauda* examined by the Biological Survey was taken at Wray, Yuma County, and is in the collection of the Colorado Historical and Natural History Society in Denver. Weasels reported present in Baca County are undoubtedly of the long-tailed species. Warren, on the authority of A. E. Beardsley,[1] records *P. longicauda* from Platte River and Greeley.

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[1] The Mammals of Colorado, p. 194, 1910.

[2] Ibid., p. 264, 1906.

[3] Fur-bearing Animals, pp. 150–151, 1877.

[4] Dartt, On the Plains and Among the Peaks, p. 220, 1879.

Putorius arizonensis Mearns. Mountain Weasel.

This weasel is tolerably common in the mountainous parts of the State, and replaces *P. longicauda* of the plains from the eastern base of the foothills westward. It has a wide vertical range and occurs on both slopes of the Continental Divide from 5,000 feet to timberline. The only other weasel found in the Colorado mountains is the much smaller *P. s. leptus*.

In 1905 and 1906 four specimens were collected at Steamboat Springs; Meeker; Higho, North Park; and Tunnel, Mesa County. Another weasel, which was not secured, ran across the trail in front of us at Boulder Falls, on Middle Boulder Creek, and took refuge in a pile of rocks. Mr. Frank Hayes, a taxidermist of Glenwood Springs, showed me several skins from the head of Noname Creek, Garfield County. Large weasels which can without much question be referred to this species were reported in Middle and North Parks; Escalante Hills; valleys of the Green, White, and Grand Rivers; Medano Springs ranch; Westcliffe; Bradford; Gardner; La Veta; Pagosa Springs; Rogers Mesa, near Hotchkiss; Placerville; and Lone Cone, San Miguel Mountains. The lumbermen at Fraser, in eastern Middle Park, report that a great many weasels live among the log piles, where they prey upon chipmunks. Mr. T. J. McKenna, of the Stevens Mill, at timberline on Mount McClellan, states that large weasels are common and tame about the mill and often come into the cabins during the heavy snows of winter. Mr. Edward A. Preble saw one at timberline on Longs Peak in 1895. There are two white winter specimens from Coventry. Warren has taken *P. arizonensis* at Colorado Springs, and states that one was killed at Crested Butte,[2] while another specimen which he sent to the Biological Survey for identification came from Sapinero. A winter specimen from Semper, Jefferson County, has been identified for Mr. W. D. Hollister, of Denver, and another from the San Luis Valley (between Monte Vista and Del Norte, November 24, 1903) for the Colorado Historical and Natural History Society. The last specimen is a male in nearly full winter pelage, and measures: Total length, 425; tail vertebræ, 155; hind foot, 46.5.

This weasel frequents the piles of large bowlders and débris in canyon bottoms and along mountain streams, where it preys chiefly upon mice, chipmunks, and Say spermophiles. When surprised in the open, it immediately seeks refuge among the nearest rocks, but once in this safe retreat its curiosity overcomes its fear, and it is seldom out of sight for more than a moment. It frisks in and out among the rocks, stopping now and then to crane its long neck at the observer, and even stands erect on its hind legs to get a better view of the object of its curiosity. Occasionally it is found at a distance from rocks. At Steamboat Springs I shot one as it ran past my camp among the alders on the bank of Bear River, and one of two specimens from near Cochetopa Pass was shot by Loring on a fence rail in a cultivated field. One seen by Prof. Lantz near Edlowe, Teller County, took refuge in a prairie-dog burrow. A weasel shot among the White River bluffs east of Meeker was carrying a large *Callospermophilus* in its mouth.

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[1] Mammals of Colorado, p. 264, 1906.

[2] Ibid., p. 265, 1906.

This is doubtless the weasel noted by Allen in Park County in 1871 and recorded as *P. ermineus,*[1] and also the species recorded by Coues as *P. longicauda* from the "mountains of Colorado."[2] A summer skin from Fort Garland, recorded by Coues and Yarrow as *P. longicauda,*[3] is not available for examination, but may be referred to *arizonensis* on geographic grounds.

Putorius streatori leptus Merriam. Dwarf Weasel.

Putorius streatori leptus Merriam, Proc. Biol. Soc. Wash., XVI, p. 76, 1903. Type from Silverton, San Juan County, Colorado.

The meager data bearing on this beautiful little weasel indicate a general distribution in the higher mountains over the State. (See fig. 27.) Very little seems to be known of its habits. Judging from verbal descriptions this is the small weasel which occasionally proves such a nuisance to trappers in the heavy forests on the higher mountain ranges by getting into marten traps in winter.

I saw a mounted specimen in winter pelage at Steamboat Springs in 1905, but beyond the fact that it was killed in the neighboring mountains the proprietor could tell nothing of its history. At Glenwood Springs, in August, 1907, Mr. William Cross, a taxidermist, told me that he had recently seen one of these diminutive weasels in brown summer pelage peering from beneath the sidewalk, but failed to secure it. Mr. Cross showed me a winter skin which he had obtained from a trapper in the Glenwood region. Mr. Anton Stark, agent of the Colorado & Southern Railroad at St. Elmo, in the Saguache Mountains, reports the dwarf weasel as not uncommon thereabouts. One which he captured in winter and kept in confinement became so tame that it was finally allowed its freedom, but remained about the house for some time and proved an expert mouser.

Mr. D. Costello, of Gardner, Huerfano County, relates an incident which occurred many years ago while he was prospecting in the mountains of northern Gunnison County, back of Crested Butte. Soon after locating in a cabin adjacent to a large rock slide just below timberline he discovered that a cony was occupying a large grass nest beneath the cabin floor. It often appeared in the cabin, coming up through a broken board in the floor, and in time became very friendly. Finally a day came when the cony did not make its usual appearance, but a tiny weasel was seen at the hole in the broken board, peering in all directions and craning its long slim little neck with the bold curiosity so characteristic of the larger weasels. Fearing for the welfare of the cony, Mr. Costello killed the tiny cutthroat, but apparently too late, as he saw no more of his interesting companion. It seems probable that the cony is often preyed upon by this weasel, as the same rock slide often harbors both animals. *P. leptus* is only about 6 inches in length, exclusive of the short black-tipped tail of 1 or 2 inches, and the body is little larger around than that of a small mouse.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Fur-bearing Animals, p. 141, 1877.

[3] Explorations W. of 100th Meridian, V, p. 59, 1875.

Mr. Walter Blanchard has presented the Biological Survey with a brown summer specimen of *P. leptus*, which was killed on his ranch 5 miles west of Boulder in June, 1902. The type specimen from Silverton, in beautiful white winter pelage, was shot by Loring October 20, 1893, as it was peering from under a log. Another immature specimen from the same locality was caught in a trap set in the underground tunnel of a pocket gopher (*Thomomys fossor*), which suggests that this gopher may form part of the weasel's bill of fare. Another specimen in the Biological Survey collection was obtained at Crested Butte February 17, 1902, by Warren, who gives the following observations on this species: "About Crested Butte, judging from the tracks one sees after a fresh fall of snow, it is quite common. It often burrows under the surface of the light snow, and runs beneath for quite a distance, then reappears on top, having been hunting down a mouse."[1] Recently *P. leptus* has been recorded from Coventry, Montrose County.[2] A male winter specimen from Larimer County is in the collection of the State Agricultural College at Fort Collins. One from Boulder County, in the Field Museum of Natural History, is recorded by Elliot.[3] A specimen from near Boulder in the mounted collection of Colorado mammals, exhibited by Mrs. M. A. Maxwell in Washington in 1876–77, has been recorded by Coues as "the least weasel, *Putorius vulgaris*,"[4] and was very likely the present form.

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[1] Mammals of Colorado, p. 264, 1906.

[2] Warren, The Mammals of Colorado, p. 198, 1910.

[3] Field Col. Mus. Pub., 115, VIII, p. 449, 1907.

[4] Dartt, On the Plains and Among the Peaks, p. 220, 1879.

Mustela caurina origenes Rhoads. Rocky Mountain Marten.

Mustela caurina origenes Rhoads, Proc. Acad. Nat. Sci. Phila., p. 458, 1902. Type from Marvine Mountain, Garfield County, Colorado.

In the dense forests of lodgepole pine and spruce which clothe the upper slopes of the higher mountain ranges of northern Colorado the marten is still present in considerable numbers. It appears to be uncommon on all the southern ranges except the San Juan Mountains, where from a point northeast of Pagosa Springs west to Silverton and Telluride it is reported in good numbers. Martens are rarely observed below 8,000 or 8,500 feet, or the lower edge of the Canadian zone forest belt. They range regularly to timberline, however, and have been seen 1,500 feet above timberline near Silverton.

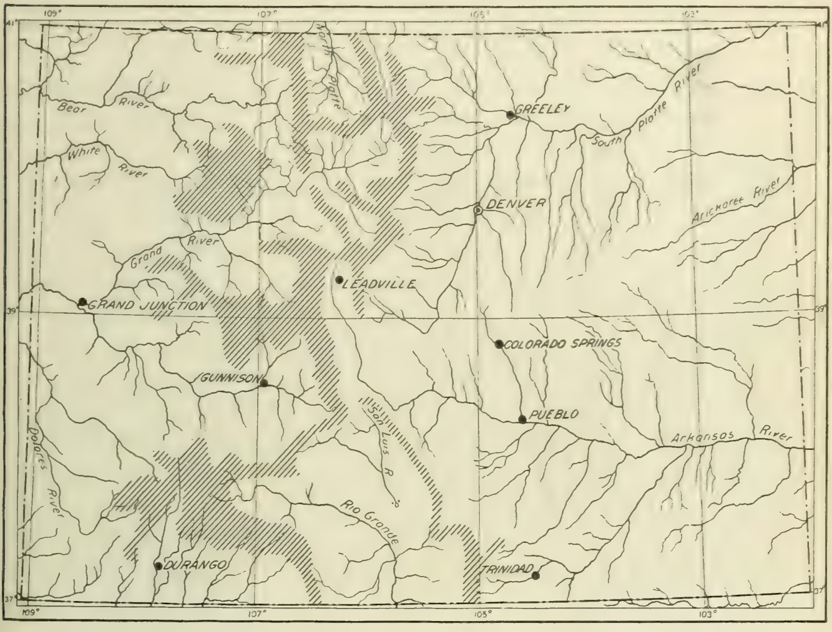
109°
107°
105°
103°
41
39°
37°
Bear River
White River
Grand River
North Platte
GREELEY
South Platte River
DENVER
Arickaree River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD

FIG. 28.—Distribution in Colorado of marten (*Mustela caurina origenes*).

Throughout their range (see fig. 28) martens are hunted and trapped extensively, and consequently are not nearly so abundant as formerly. Ski are often used in hunting them in winter, when snow covers the mountains to a depth of several feet, and when pursued in this manner the animals quickly take refuge in trees, where they are easily shot. Hunting martens on ski is said to be very exciting sport, and at times hazardous, owing to the roughness of the country. This is a favorite method of hunting in Middle Park and in the San Juan Mountains. Most of the martens secured, however, are taken in either steel traps or deadfalls. Although Colorado martens are somewhat paler than those farther north, they nevertheless yield a valuable fur.

Most of my information on the present distribution and abundance of martens relates to the northern half of the State. During the period from 1900 to 1905 the following were considered the best regions for martens: The mountain ranges surrounding Middle and North Parks; the Williams River Mountains and the eastern part of the White River Plateau, west of Egeria Park; and the mountains south of Aspen, Pitkin County. Mr. Fred N. Selak, of Coulter, Middle Park, informed me in 1905 that he handled from 25 to 30 marten skins each year, taken chiefly in the Rabbit Ear and Williams Mountains and along the western slope of the Front Range near Arapahoe Peak. Alpert & Co., of Kremmling, receive a few skins each year from the Gore Mountains. Mr. W. H. Graham, of Spicer, North Park, states that he usually traps between 10 and 20 martens each winter in the Rabbit Ear Mountains, near the head of Arapahoe Creek. The animals are reported common on the Park Range but very rare on the Medicine Bow Range. Many trappers market the fur in Denver. A conservative estimate of the annual catch in the Middle and North Park region would be 100 skins.

In August, 1905, Mr. Frank Hayes, a taxidermist of Glenwood Springs, showed me skins of four martens trapped the previous winter at Bennett's Well, on the head of Noname Creek, 8 miles northeast of that point. He had also purchased a number of skins taken on Divide Creek, south of Newcastle, and at Mud Springs, on the White River Plateau. Mr. Hayes was located at Aspen about 1900, and handled between 40 and 50 marten skins each year, nearly all of which came from near the Montezuma mine, on the east slope of Hayden Peak. Two other fur buyers were located in Aspen at the same time, and Mr. Hayes estimates that fully 100 skins were marketed there annually. This region is probably at present the best marten country in Colorado. Mr. Robert McIntosh, of Slater, received 10 marten skins from the Elk Head Mountains during the winter of 1905–6. Martens are reported rare on the high timbered divide east of Laramie River and on the headwaters of Grand Encampment River.

Mr. Steve Elkins, of Mancos, reports a few in the spruce belt of the La Plata Mountains, and I am informed they are tolerably common in the extensive forests of Engelmann spruce on the mountains west of Rico. They seem to have been always rare on the Sangre de Cristo Range. Mr. E. W. Scott, of La Veta, has the skin of a marten killed in the spruce belt on East Spanish Peak in the winter of 1904–5, and states that he has seen three other marten skins from the same mountain. Mr. T. J. McKenna, of Denver, states that 30 years ago he trapped a great many martens near the Tin Cup mine, and on the headwaters of the Cimarron River, in Gunnison County. Skins which Loring saw at Grand Junction in 1893 probably came from the Grand Mesa country.

The type and one topotype of *M. origenes* in the National Museum were collected in Garfield County, near Mount Marvine, in September, 1901, by Mr. E. Thompson Seton. The skulls may be readily distinguished from those of *M. americana* by the small, flattened, rectangular bullæ and the peculiar saddle-shaped upper posterior molar.

(?) **Mustela pennanti** Erxleben. Fisher.

In his list of the mammals of Park County, Allen records the fisher as "more or less common."[1] I have made careful inquiry of old hunters and trappers throughout the heavily forested region of the northern Colorado mountains and have yet to meet one who is familiar with the fisher or who has even heard of the animal within the State. Warren does not record it and it seems probable that Allen's record was based on erroneous information.

Gulo luscus (Linnæus). Wolverene.

In the high Canadian zone forests of the wilder parts of the mountains the wolverene is still occasionally seen. While never common in the State, it was formerly of general occurrence. At present it appears to be restricted largely to the San Juan and La Plata Mountains, the mountains of northern Gunnison County, and the ranges surrounding North and Middle Parks.

Mr. W. H. Graham, of Spicer, North Park, states that wolverenes are occasionally reported from the Rabbit Ear Mountains, but that very few have been killed during recent years. He saw a track on the head of Arapahoe Creek during the winter of 1904–5, and in the fall of 1903 saw a wolverene which a trapper caught on Owl Mountain, in southeastern North Park. The wolverene was considered very rare in Middle Park in 1905. Mr. Fred Selak, of Coulter, reported that one was killed in the fall of 1903 near the head of Ranch Creek, on the western slope of the Front Range. Two skins, which were purchased by Alpert & Co., of Kremmling, in 1903, were said to have been trapped the previous winter in the heavy forests on the head of the Williams Fork of Grand River. Mr. T. J. McKenna, of Denver, states that while at the Tin Cup mine, in Union Park, Gunnison County, in the summer of 1883, he saw a wolverene which had been killed in that vicinity. He says it was not at all rare in the mountains of Gunnison County 25 or 30 years ago.

Mr. Wood Galloway, of Norwood, states that for many years his father had a wolverene skin, taken in Antelope Park, Mineral County, and says the animals were not at all uncommon in that section 30 years ago. A wolverene shot at the east base of Pagosa Peak in the winter of 1905 was mounted and on exhibition in Pagosa Springs until 1907, when it was sent to Denver with a miscellaneous mounted collection. Mr. H. N. Wheeler, formerly supervisor of the Montezuma National Forest, has a wolverene skin said to have been taken in the spruce belt near Calico Mountain, west of Rico, in 1905, and through other sources I learn that these animals are of occasional occurrence in the La Plata Mountains. One is said to have been killed near the Silver Picket mine, on Mount Wilson, in the San Miguel Mountains, about 1895, and according to Mr. D. Costello, of Gardner, one was killed on the head of Huerfano River many years ago.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

Allen says the wolverene was not uncommon in Park County in 1871, and he saw the skin of one taken near Montgomery;[1] while it formerly occurred in Clear Creek County, according to Trippe.[2] Coues mentions a specimen in the collection of Colorado mammals exhibited by Mrs. M. A. Maxwell at the Philadelphia Exposition. It was caught in a steel trap in the mountains near Boulder.[3] In an interesting general account of the wolverene Mr. C. A. Cooper describes his capture of an old male in the heavy forest on the summit of Gore Pass, between Middle and Egeria Parks, during the winter of 1883, and also mentions four beautifully marked wolverene skins which he examined at Trappers Lake, Garfield County, in the winter of 1889,[4] while a companion of Cooper's reported seeing a wolverene in Rock Creek Canyon, Egeria Park, in 1888.[5] Warren records a wolverene taken near Irwin, Gunnison County, about 1890, and states that he saw fresh tracks in the snow near Irwin in October, 1905, at an elevation of 11,000 feet.[6] A specimen in the Carter collection in the Colorado Museum of Natural History was taken near Breckenridge, Summit County.

Bassariscus astutus flavus Rhoads. Civet Cat; Cacomistle.

The data at hand bearing on this handsome and interesting animal are rather meager and unsatisfactory, and probably do not well indicate its distribution and abundance in Colorado. The species appears to be restricted to the Upper Sonoran zone, and with a single exception all the records are from the rough canyon country in the lower southwestern part of the State from the Grand River Valley southward.

The civet cat is tolerably common on Mesa Verde and thence north to the southern base of the Uncompahgre Plateau. In June, 1907, I saw its small, round, cat-like tracks in the dust beneath many of the overhanging rock ledges along Navajo Canyon, 25 miles southwest of Mancos; while among the Spruce Tree Cliff Ruins at the head of this canyon, and particularly in the darkest recesses of the cavern behind the ruins, the footprints of civet cats, leading here and there among the numerous smaller tracks of cliff mice and wood rats, were plainly discerned in the thick layer of fine rock dust. However, none came to meat-baited traps which I scattered along the ledges. Mr. Steve Elkins, of Mancos, states that he has seen a civet cat which was killed in Mancos Canyon. This species is not reported in McElmo Canyon, and seems to be little known to the hunters of Montezuma County, but this is not strange, since it is nocturnal, and in hunting for cliff mice and wood rats rarely leaves the caves and deeper recesses in the rocky walls of canyons. A mounted specimen which I saw in Durango probably came from either Montezuma County or southern La Plata County.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] See Coues, Birds of the Northwest, p. 224, 1874.

[3] Dartt, On the Plains and Among the Peaks, p. 219, 1879.

[4] Big Game of North America, pp. 479–501, 1890.

[5] Ibid., p. 492, 1890.

[6] Mammals of Colorado, p. 262, 1906.

The civet cat is more generally known in the region bordering the lower San Miguel and Dolores Rivers. Mr. Henry Huff, an Indian living at Norwood, who trapped in the Dry Creek Basin, in western San Miguel County, during the winter of 1906–7, states that the "ring-tails" are not at all uncommon among the ledges of that region. A fine adult civet cat caught by him and an immature individual taken the same winter in the canyon of San Miguel River, a few miles north of Coventry, are in the Warren collection. Civet cats are reported from the Tabeguache Canyon, north of the San Miguel, and Mr. J. P. Galloway, of Norwood, informed me of five which were killed some years ago at the Sunrise copper mine in West Paradox Valley.

There are three Mesa County records of civet cats. In June, 1893, Loring saw a skin in a fur buyer's store at Grand Junction which was said to have been taken the previous fall about 4 miles from that place. A specimen which the National Museum obtained from Conductor Tuttle of the Colorado Midland Railway, was caught by a trapper in Mesa County a few years ago, and was mounted by Mr. C. E. Aiken, of Colorado Springs. The history of this specimen is given by Dr. W. W. Arnold in Outdoor Life.[1] Warren records *Bassariscus* from Delta on the authority of A. E. Beardsley.[2] An animal answering its description was reported to Mr. C. E. Aiken from Beaver Creek, Fremont County, some 25 miles south of Colorado Springs, in 1904.

Procyon lotor (Linnæus). Raccoon.

The data on the distribution and abundance of the raccoon within the State are somewhat limited and probably do not indicate the extent of its range. It is tolerably common on the eastern plains, along some of the larger foothill streams, and in the extreme south from the San Luis Valley west to La Plata County. According to Warren, the animal has been taken in Grand County, west of the Front Range.[3] It has not been found in the lower northwestern part of the State. Whether the raccoons which reach the southern counties from the south and southwest, along the Rio Grande and the San Juan River and tributary streams, are distinct from those east of the mountains is not certain, as no specimens are available for comparison. It seems probable, however, on geographic grounds, that the raccoons occurring west and south of the San Juan Mountains, in Archuleta and La Plata Counties, are *P. mexicanus*. The raccoons which were reported in 1907 from the San Luis Lakes and the cottonwood-fringed streams at the western base of the Sangre de Cristo Range may have reached the San Luis Valley from the east by crossing over the low Mosca Pass from the head of the Huerfano River.

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[1] Outdoor Life, p. 933, Nov., 1905.

[2] Mammals of Colorado, p. 260, 1906.

[3] Further Notes on Mammals of Colorado, p. 83, 1908.

Raccoons are stated to be common at a number of points on the plains east of the mountains, and probably occur along all the larger streams, which are well fringed with cottonwoods, and follow them some distance into the foothills. There is a skull from the foothills near Arkins, Larimer County, and the distribution in the foothills is further indicated by reports from Gardner and La Veta, Huerfano County. A specimen in the Warren collection from the mouth of the Platte Canyon, Douglas County, has been examined by the Biological Survey. Raccoons are said to be tolerably common in the marshes and along streams in the Loveland region. Loring, who secured a specimen at Loveland in 1897, states that he captured it in a cat-tail marsh which was bordered by a fringe of cottonwoods, and he thinks the animals were living in holes in the banks at that point, rather than in hollow trees. At Las Animas in July, 1892, Dr. A. K. Fisher noted along the Arkansas River and on the banks of irrigation ditches a great many tracks made by raccoons searching for frogs. Prof. D. E. Lantz reported a few raccoons on Big Sandy Creek, near Hugo, in 1905. Warren says they are found at Watervale, in south central Las Animas County.[1]

In May, 1909, raccoons were abundant among the sandstone ledges along the South Fork of the Republican River at Tuttle and in similar situations at Wray, while many tracks were seen on sandbars in the South Platte River 2 miles northeast of Sterling. Several dens were located among the rocks near Tuttle, at one of which, within 50 yards of our camp, a large, dark-colored female raccoon was trapped. Dismal howls and barks, not unlike those of a dog, advised us of her capture one night about 10 o'clock. The raccoons at Tuttle were feeding extensively upon grasshoppers, and the excrement found near the dens consisted very largely of the remains of those insects.

Raccoons are said to follow up the Los Piños as far as Bayfield, La Plata County, and are found in small numbers along the San Juan River to Pagosa Springs, but I was informed at both localities that prior to 10 or 15 years ago none were present. At Arboles I saw tracks in a dry arroyo extending north from the San Juan River.

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[1] The Mammals of Colorado, p. 219, 1910.

Ursus americanus Pallas. Black Bear.

The black bear is still tolerably common in the wilder parts of the mountains, especially in the ranges surrounding North, Middle, and Egeria Parks, and in the Elk, Saguache, San Juan, and La Plata Mountains, where the forests are most extensive. It is dichromatic, as in other parts of the Rocky Mountains, and the numerous skins examined and the statements of hunters and trappers indicate that black, brown, and cinnamon animals frequently occur in the same localities. The typical black phase is least common in the southern mountains and at the lower elevations, but is more frequent in the northern part of the State.

In a series of nine very large skins which I examined in the store of Fred Selak, near Coulter, Middle Park, five were brown and four black. They had been purchased from a trapper living in the Vasquez Mountains, near the headwaters of the Williams Fork of Grand River. Most of them had been taken in large log traps, and as a consequence had mutilated their claws by their efforts to escape. A number of bears are killed each spring in the lodgepole pine and spruce forests on the mountain ranges bordering Middle Park, and skins from this section brought about $25 each in 1905–6. In the aspen forests on the White River Plateau, and near Arapahoe Pass, in the Rabbit Ear Mountains, many of the larger trees were badly scarred to a height of 8 feet or more by the claw marks of bears. In October, 1906, I saw the tracks of a medium-sized bear in the snow above timberline near Berthoud Pass. Bears were reported in varying numbers in 1905–6 on the Medicine Bow, Park, and Gore Ranges, Elk Head and Williams River Mountains, Danforth Hills, and Mount Cullom, west of Green River. Tracks are said to have been seen among the pinyons near Douglas Spring, in the Escalante Hills, in the winter of 1905–6. At Glenwood Springs I saw many skins from the high country south of Grand River and others from the White River Plateau.

Bears are now becoming scarce on the eastern slopes of the Front Range. In 1893 Loring reported them common in the Estes Park region, one trapper having killed 14 in three years; but the animals are stated to be rare at present in the higher parts of Clear Creek County (Floyd Hill and Grays Peak).

Bears were not considered uncommon in the mountains of southern Colorado in 1907, being reported in greatest numbers in the Cochetopa Hills, in the San Juan Mountains north of Pagosa Springs and Vallecito, in the La Plata Mountains northeast of Mancos, and in the San Miguel Mountains from Mount Wilson west to Lone Cone. They occur more or less commonly the entire length of the Sangre de Cristo and Culebra Ranges, particularly on the more heavily forested eastern slopes, and also in the West Elk Mountains and on the

Uncompahgre Plateau. They are rare in the rough parts of Las Animas County. Prof. Lantz heard of one which was killed 20 miles south of Higbee about 1908.

In the Pagosa Springs region, as elsewhere, bears are usually found in the aspen and spruce belt, but they occasionally come down from these elevations into the yellow pine forests and kill many sheep. The winter dens are left about May 1, or sometimes earlier, and, as sufficient snow for tracking remains in the higher country for another month, May is considered an excellent time for bear hunting. Most of the hunting is done with hounds, and large packs of bear dogs are owned at both Pagosa Springs and Mancos, which are probably the best two outfitting points for bear hunts in the southern mountains. A number of hunting parties were located in the mountains north of Pagosa Springs at the time of my visit, late in May, 1907. A large black bear was killed on Pagosa Peak May 30, and a little earlier in the same month an old female and cub were killed on Middle Mancos River, 10 miles east of Mancos. A brown cub was roped at the Evans sawmill, near Vallecito, a few days before I reached there, June 5. Mr. Steve Elkins, of Mancos, one of the most successful bear hunters in southwestern Colorado, states that the largest black bear which he has killed in the La Plata Mountains weighed very nearly 500 pounds.

In the San Miguel region bears appear to occur regularly at a lower altitude than elsewhere in Colorado, and are not uncommon down into the pinyon country. One is said to have been killed within a mile of Placerville in the spring of 1907, while in the well-settled country between Coventry and Norwood a large brown bear was seen at the carcass of a cow in an open field a few days before my arrival, July 1. The animals are occasionally seen along Naturita Creek near Coventry. In the pinyon country of western San Miguel and Montrose Counties the cinnamon phase prevails, and very light colored individuals are not uncommon. Mr. Henry Huff, an Indian living at Norwood, showed me the skin of a remarkably light colored yearling cub which he had captured in the Dry Creek Basin by crawling into the den after killing the mother, an old cinnamon, and the other cub. This skin was a pale creamy yellowish white throughout, with the exception of the face and nose, which were very light brown.

Bear signs were abundant in the aspen belt on Lone Cone late in July. A great many of the aspens were scratched and clawed, many of the marks being recent. Two trees showed plainly where the animals had climbed to the upper branches—sure evidence that they were not grizzlies. The claw marks on these trees were very distinct to a height of 30 feet or more. (See fig. 29.) Other bear signs—chiefly overturned logs and rocks where the animals had been searching for ants and beetles—were abundant on Lone Cone, and indicated that the region was one of bruin's favorite ranges.

The Biological Survey has a series of 10 bear skulls which Mr. Theodore Roosevelt secured on Divide Creek, Garfield County, in April, 1905; also three from Pagosa Springs, taken in the summer of 1907. Skulls in the National Museum were collected by Mr. E. Thompson Seton in the Rifle region and near Mount Marvine. Allen found black and cinnamon bears in about equal numbers in Park County in 1871.[1] Coues and Yarrow mention a specimen obtained by Lieut. Marshall at Pagosa Springs in 1874.[2]

Ursus horribilis Ord. Grizzly Bear; Silver-tip.

At present grizzly bears are uncommon, if not rare, in the northern mountains, but are occasionally seen in the wilder mountains of southern Colorado, particularly in the San Juan, La Plata, and San Miguel Ranges. Many of the data respecting the grizzly (or silver-tip, as it is generally known to hunters) within the State, past and present, are unsatisfactory and somewhat conflicting, many of the reports undoubtedly referring to black bears, or more often to large cinnamon bears.

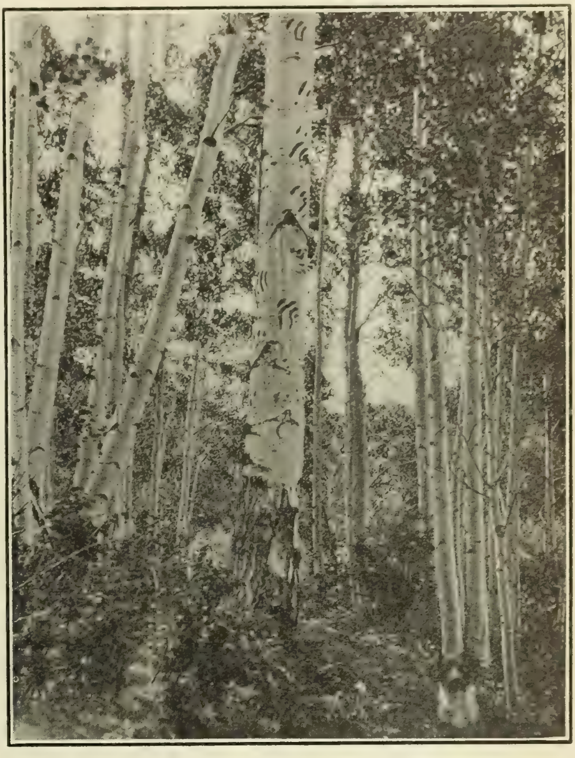

Fig. 29.—Claw marks of black bear on aspen (*Populus tremuloides*), Lone Cone, San Miguel Mountains, at 10,000 feet.

In 1905–6 the best informed hunters and trappers in the northern mountains considered the grizzly rare. The reports which follow seem to refer beyond question to this species. A very large old silver-tip was reported in the region about Strawberry and Grand Lakes, in northeastern Middle Park, in 1905. This old fellow is said to have ranged that part of the western slope of the Front Range for a number of years, and is well known to the hunters of the region as Old Saddleback—so called because of an area of light-colored fur near the middle of the back.[1] Another very large bear was reported the same year from Mount Baker, at the eastern end of the Rabbit Ear Mountains, and according to well-informed hunters a few silver-tips were yet to be found in the vicinity of Pyramid Peak, in the mountains west of Egeria Park. The skin of a two-thirds-grown silver-tip killed near Sleepy Cap, Williams River Mountains, in October, 1890, by Mr. Oscar Lampton, of Montrose, has front claws 3 inches in length, following the curve. Lumbermen at the tie camps on the headwaters of Grand Encampment River, at the northern end of the Park Range, stated that a large silver-tip often came about the camps during the spring of 1906. Mr. William Cross, the Glenwood Springs taxidermist, showed me a photograph of the skin of a very large silver-tip killed in October, 1906, on the northern side of the Book Plateau, in extreme western Garfield County, by Mr. Harry Payne Whitney, of New Haven, Connecticut. This bear, judging from the photograph, was a remarkably large one, and the claws on the forefeet were very long and regular. The longest fore claw (measured by Mr. Cross) was exactly 4½ inches along the curve. The skull in Mr. Cross's shop was very large and massive and indicated an old animal. Mr. Cross stated that at least two silver-tips have been killed in the mountains near Gypsum during recent years—a large individual in the spring of 1903 on the head of Gypsum Creek by Mr. Muckey; and another bear, nearly grown, in the same region in the spring of 1907 by Mr. Jake Borah, the veteran Meeker hunter.

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[1] Bull. Essex Inst., VI, p. 54, 1874.

[2] Explorations W. of 100th Meridian, p. 67, 1875.

I have no data respecting the recent occurrence of this bear along the eastern slopes of the Front Range, and it appears to be now extremely rare or entirely absent. In the early seventies of last century grizzlies were not uncommon along the higher crests of the Front and Saguache Ranges. Brewer mentions six which he saw above 13,000 feet in the mountains in close proximity to Grays Peak and near Mount Yale, and says: "Judging from the few seen and from skins examined in Denver, they are smaller than those of California, the hair not so long and shaggy, the color more silvery, or truly grizzled."[2]

In the summer of 1907 considerable information was secured on the present range and abundance of the silver-tip in the southern mountains. Small numbers are found in the San Juan Mountains north of Pagosa Springs and Vallecito, and according to Forest Ranger E. E. Chapson, an average of one or two had been killed north of Pagosa Springs each spring until 1907, when none were killed. Silver-tips kill a number of cattle in the southern foothills of the San Juan some years, one having killed four head in the country to the west of Pagosa Peak in May, 1907. This is doubtless the same individual which was reported as killing cattle on the middle fork of Piedra River a few weeks later. Henshaw states that grizzlies were quite common in the higher San Juan Mountains as late as 1873. As far as could be learned, the silver-tip has a higher range than the black bear, and is rarely met with as low as the yellow pine belt.

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[1] Doubtless an extreme of the ordinary grizzling or silver tipping of the hairs, which is normally heaviest on the saddle and between the shoulders.

[2] Am. Nat., V, p. 221, 1871.

Mr. Steve Elkins, of Mancos, states that the silver-tip is encountered rather often in the La Plata Mountains and that he has killed several during the past 10 years. Among these and other skins from the La Plata region examined by Mr. Elkins, much individual color variation was exhibited, some being a faded dirty yellowish, with the hair long and shaggy, while others were dark clove brown or blackish, with hair well silvered at the tip—sleek, short-haired, and beautiful animals. The skin of a large silver-tip which was trapped on West Dolores River in the spring of 1906 is owned by Mr. Harry Pyle, of Dolores.

A silver-tip was shot on North Mesa, just west across the Naturita Valley from Lone Cone, San Miguel Mountains, October 2, 1905, by Mr. Oscar Lampton, of Montrose. In Montrose Mr. Lampton showed me the skin of this bear in the form of a beautiful full-head rug with the skull inside. It was a good-sized animal with the longest fore claws measuring 4 inches, but the unworn teeth indicated that it was young. The foreclaws on the skin of a large old cinnamon bear from the Uncompahgre Plateau, 15 miles west of Montrose, are markedly smaller and shorter than those of the smaller of Mr. Lampton's two silver-tips (from the Williams River Mountains). The silver-tips are both in good fur and agree precisely in color, being a uniform grizzled black-brown on the back; the legs, a rich dark shade of the same color without the grizzling; face, plain brown; nose, clay brown; claws, black.

Mr. Henry Huff, an Indian, and Mr. J. P. Galloway, both of Norwood, killed a very large old male silver-tip among the Engelmann spruces just below timberline on the west slope of Lone Cone, San Miguel Mountains, May 26, 1907, after a long chase from the lower north slope of the mountain. A female bear seen at the same time escaped, and is said still to range the Lone Cone country. The snow was reported to have been 8 feet deep where the old male was dispatched, and hence it was with some misgivings that we set out on July 27 to secure the skull. The Indian led us straight to the spot, however, in a dense spruce thicket where the down timber was heaviest. The snow had but recently melted, and the immense carcass had settled across a large log. Mr. Galloway estimated the weight of the bear when killed at between 800 and 1,000 pounds, and states that the skin at the time of its removal from the body was so heavy that he and his companion had great difficulty in packing it upon a horse. The stomach of this bear, examined on the day it was killed, contained nothing but a double handful of ants and the larvæ of wood-boring beetles. Fortunately, the skin was at a near-by ranch at the time of my visit to Lone Cone, and I measured and photographed it. The pelt was in prime condition, with a uniformly short, dense pelage, shortest on the back between the shoulders, where the hair averaged about 3⅛ inches in length, and longest on the sides of the upper forelegs, where it averaged 6¼ inches. The Indian aptly likened the flaps of long shaggy hair on the upper forelegs to a cowboy's chaps, and said the resemblance in life was most striking. The fur was a dark, rich clove brown at base throughout, shading into plain brownish black on sides and on fore and hind legs; ears and face, dark brown; nose, clay brown; dorsal area, from rump to between ears, a beautiful silvery clove brown, brightest between shoulders, owing to greater length of silvered area at tips of hairs. The ears were comparatively short, but could not be accurately measured on the dried skin. The following skin measurements indicate the large size of this bear, although they are probably somewhat exaggerated on account of stretching: Distance between tips of fore claws, outstretched skin, 96½ inches; length from tip of tail to end of nose, outstretched skin, 87 inches; longest fore claw, along curve, 4¼ inches; across angle (straight), 3⅛ inches; hind claws (badly worn), under 1 inch. Mr. Galloway's flesh measurements of hind foot were: Heel to tip of claws, 12½ inches; across base of toes to edge of hair on side, 7½ inches. The old age of this bear was indicated by the much-worn teeth and hind claws. One of the massive upper incisors was a mere stub, having been broken off for some time. Several rifle balls had penetrated the posterior part of the skull and badly shattered it, but the anterior part was in good condition.

Mr. E. R. Warren, of Colorado Springs, has in his collection the skull of a medium-sized silver-tip which was killed some years ago in the Dry Creek Basin, west of the San Miguel Mountains, by Mr. Jack Watson, of Norwood. The Dry Creek Basin is Upper Sonoran country, the altitude being not over 6,000 feet—an unusually low elevation for the silver-tip.

While on Lone Cone, July 27, I photographed a large aspen which plainly showed fairly fresh claw marks of a large bear, apparently a silver-tip, to a height of 13 feet. Several other aspens on the upper slopes of Lone Cone were claw-marked by silver-tips, but most of the scratching was old.

Grizzlies are becoming very scarce on the Sangre de Cristo and Culebra Ranges, but are still occasionally encountered among the Cochetopa Hills west of Saguache. A large individual is said to have been taken in a trap on the head of Trinchera Creek in the spring of 1907 by Mr. George Wheeler, of Fort Garland. That the grizzly was occasionally met with east of the mountains in early times is shown by an account of a bear which killed Lewis Dawson, a member of Jacob Fowler's party, at the mouth of Purgatory River in 1821.[1]

The National Museum has the skin and skull of a grizzly killed near Twin Lakes July 28, 1876; a skull from Burro Mountain, near Elwood, in the San Juan Mountains; and two skulls of bears killed on Miller Creek, in the Glenwood Springs region, in either 1896 or 1897. The Biological Survey has skulls from Pagosa Springs and Lone Cone, and Coues and Yarrow mention a skin secured near Pagosa Springs in 1874 by Lieut. Marshall.[2]

Scalopus aquaticus intermedius (Elliot). Plains Mole.

Moles enter the northeastern part of the State from the plains. Thus far they are known only from Yuma County, but very likely occur throughout the sand hill region from the Arickaree Valley north at least to Holyoke. I found them abundant at Wray in December, 1907, in the valley along Chief Creek, and especially numerous in the young apple orchard of Mr. W. E. Wolfe, a mile east of the town. The loose sandy loam soil of this orchard of several acres was furrowed with a network of mole runways. Notwithstanding the great abundance of moles on his ranch, Mr. Wolfe has detected no injurious effects from their presence, and considers that they confer a benefit by thoroughly working over the surface soil in search of worms. A male was trapped in Mr. Wolfe's orchard December 13, when the ground was partially frozen and covered with a 3-inch fall of snow, which is good evidence that moles are active in loose soil during winter weather. I again visited Mr. Wolfe's orchard in May, 1909, but found only one fresh mole runway. Several older runways seen, however, indicated that the animals either were inactive or were working at a considerable depth. In driving from Wray to Yuma I saw mole runways in the sand at two points, 5 and 12 miles, respectively, west of Wray. At Yuma a small colony was working in soft soil on the embankment along the Burlington Railroad a mile east of town. No signs of moles were seen in driving northwest from Yuma to Sterling.

The Wray specimen agrees very closely with topotypes of *S. a. intermedius* from Alva, Oklahoma, in small size, pale coloration, and particularly in small size of skull. The skull of this specimen measures: Total length, 33.9; mastoid breadth, 17.4; palatal length, 15. Skin measurements are: Total length, 145; tail vertebræ, 28; hind foot, 23.

An alcoholic specimen from Dry Willow Creek, 12 miles southeast of Wray, in the collection of the Colorado Historical and Natural History Society, has been recorded by Warren.[3]

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[1] Journal of Jacob Fowler. New York, 1898.

[2] Explorations W. of 100th Meridian, V, p. 66, 1875.

[3] Further Notes on Mammals of Colorado, p. 84, 1908.

Sorex personatus I. Geoff. St. Hilaire. Masked Shrew.

This species is apparently far less common and widely distributed in the Colorado mountains than *S. obscurus*, although at one point—St. Elmo, at 10,000 feet in the Saguache Mountains—it was the more common of the two. I have found it at only two localities in the mountains of northern Colorado—an adult male being taken at 9,000 feet on Arapahoe Pass, Rabbit Ear Mountains, in a damp, mossy place on a cold north slope; and a female being trapped in a cold bog near Pearl, in the northern end of North Park, at 8,500 feet. At St. Elmo, in October, 1907, eight specimens of *S. personatus* were taken in three nights' trapping, chiefly beneath mossy rotten logs in the damp thickets of Engelmann spruce along Chalk Creek. The above specimens are in all respects typical *S. personatus*, but one from Loveland, at the eastern base of the foothills, shows an approach to the paler and grayer plains form *S. p. haydeni*.

Several specimens of *S. personatus* taken by Mr. R. T. Young in the vicinity of Boulder, and at Buchanan Pass, Boulder County, are in the National Museum. Others from Irwin, Gunnison County, at 10,700 feet; Lake Moraine, El Paso County, at 10,250 feet; and Mud Springs, on the White River Plateau, at 8,850 feet, are in the Warren collection. Warren states that he has recently identified specimens from the Summit House on Pikes Peak, 14,147 feet altitude.[1] A specimen from Marvine Lodge, Rio Blanco County, is recorded by Felger.[2]

Sorex obscurus Merriam. Rocky Mountain Shrew.

This is the common shrew of the high Colorado mountains in the Canadian and Hudsonian zones. Specimens from timberline on Longs Peak and Mount McClellan indicate its upper limits, while on cold slopes and along streams, where the conditions are semiboreal, I have taken it as low as 5,800 feet, and it has recently been recorded from Boulder (5,400 feet).[3] It is usually trapped in mountain bogs and beneath moss-covered rotten logs in spruce and aspen forests. In a grassy mountain park near Gore Pass, between Egeria and Middle Parks, one was secured in a runway of *Microtus nanus*, at some distance from the forest; while Loring trapped a specimen in a cabin near Silverton. Three of these shrews got into my traps set among rank vegetation in an aspen bog near Uncompahgre Butte, on the Uncompahgre Plateau, at 9,000 feet, July 17, 1907. At St. Elmo, in the Saguache Mountains, at 10,000 feet, I collected two specimens in October in the damp spruce thickets along Chalk Creek. This shrew was not so common as *S. personatus* at this point. The mountain shrew is chiefly nocturnal, but Loring caught one at Gold Hill during the daytime, and one afternoon at Baxter Pass, on the Book Plateau,

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[1] The Mammals of Colorado, p. 263, 1910.

[2] Univ. of Colo. Studies, VII, No. 2, p. 146, 1910.

[3] Young, Proc. Acad. Nat. Sci. Phila., p. 407, 1908.

I saw one running about under a spruce log. Specimens of this species from a great many Colorado localities are in the Biological Survey collection.

Sorex vagrans dobsoni Merriam. Dobson Shrew.

A specimen of the little Dobson shrew from Lake Moraine, El Paso County, which Warren sent to the Biological Survey for determination in 1905, is the only Colorado record. It was collected at an altitude of 10,250 feet.

Sorex tenellus nanus Merriam. Dwarf Shrew.

Sorex tenellus nanus Merriam, N. Am. Fauna No. 10, p. 81, 1895. Type from Estes Park, Larimer County, Colorado.

This little shrew must be very rare, as not one was captured in my three seasons' work on all the higher mountain ranges of the State.

In addition to the type, an adult female taken in Estes Park August 3, 1895, by Mr. Edward A. Preble, the Biological Survey has a skull from Westcliffe, Custer County. A third specimen from Colorado, in the Warren collection, has been identified by the Biological Survey. It was collected on Bear Creek, in the mountains near Colorado Springs.

Neosorex palustris navigator Baird. White-bellied Water Shrew.

In the Colorado mountains the large water shrew is found chiefly between 7,500 and 10,500 feet, in the Canadian zone, but I have taken it at 6,400 feet, and it has been reported once from as low as 6,000 feet. The scattered localities at which specimens have been taken indicate a general distribution over the mountainous sections. The species is always found near water, and is usually taken in traps set in the moss at the edge of mountain streamlets, or in the dense vegetation of cold bogs or mountain meadows. Little is known of its habits.

At St. Elmo, in the Saguache Mountains, I found these shrews common along some small streams tributary to Chalk Creek, in October, 1907. Three out of four specimens collected at this point were taken in traps placed on moss-covered rocks behind a small waterfall, where the vegetation was saturated by the dashing spray. Mr. J. W. Frey, of Salida, reports water shrews as common on a small stream heading on the east slope of Round Mountain, at the northern end of the Sangre de Cristo Range; and they are reported from the head of Muddy Creek, in northwestern Huerfano County. In a long line of traps set along Maverick Creek, 2 miles northeast of Coventry, the night of July 4, I secured three water shrews, all being taken in traps beneath waterfalls. The elevation is 6,400 feet, exceptionally low for this shrew, and the pinyon and juniper clad bluffs bordering the Maverick gave anything but a boreal environment to this species, which is so closely associated with cold dashing mountain streams, mossy rocks, and towering spruces. At Coventry I was informed water shrews are occasionally seen at the Stephens ranch, in the western end of West Paradox Valley, at a little under 6,000 feet. There are a number of cold springs, bordered with a dense growth of water cress at this point, which is at the eastern base of the La Sal Mountains.

Specimens in the Biological Survey collection are from Gold Hill; Elkhorn, Larimer County; Cochetopa Pass; St. Elmo; Almont; Hermit; Rico; and Coventry. Loring saw the skin of one of these shrews at Silverton. The National Museum has specimens from Black Hawk; Middle Park; Mount Elbert; and old Fort Massachusetts, near Fort Garland. Others from Crested Butte and Lake Moraine are in the Warren collection.

Corynorhinus macrotis pallescens Miller. Big-eared Bat.

Very little information is at hand regarding the range of the big-eared bat in Colorado. Thus far it appears to have been taken at only five localities, all of them along the eastern base of the foothills. A specimen in the collection of the Colorado Agricultural College, secured at Fort Collins by Mr. S. Arthur Johnson, has been identified by the Biological Survey. Miller records another specimen from Larimer County,[1] and Mr. A. E. Beardsley has taken two of these bats at Trinidad, according to Warren.[2] More recently Mr. R. T. Young has recorded a specimen collected in Boulder Canyon, at an approximate elevation of 7,000 feet.[3] Junius Henderson, curator of the museum of the University of Colorado, Boulder, informs me of the capture of a specimen in a tunnel at Crisman, Fourmile Canyon, Boulder County, at an altitude of 7,000 feet, by John J. Blanchard, November 1, 1909.

Nyctinomus mexicanus Saussure. Free-tailed Bat.

Four males of this austral species from Newcastle, Garfield County, have been identified for Warren, who states that he secured them along with a number of brown bats (*Eptesicus fuscus*), July 16, 1907, "behind a sheet-iron shutter on a building where they had gone for shelter during the day."[4] The elevation of Newcastle is 5,374 feet.

Nyctinomus has not been taken elsewhere within the State, or indeed anywhere in the neighboring parts of New Mexico, Arizona, and Utah. The Newcastle record is therefore a very great northward extension of known range for the Rocky Mountain region. The animal must reach this point from the southwest through the warm Grand Valley extension of the Colorado River Sonoran area; and it is noteworthy that this Lower Sonoran species should be found near the extreme upper edge of a narrow tongue of the Upper Sonoran zone, surrounded on all sides except the west by broad belts of boreal country. The occurrence of the free-tailed bat at Newcastle suggests that it may be found in the lowest and warmest valleys of the southwestern counties, particularly in the Grand Valley between Grand Junction and the Utah boundary, which is the lowest and most truly desert-like part of the Upper Sonoran area in western Colorado. Hitherto the northern known limit of range in the Colorado Valley has been Grand Falls, Arizona, in the valley of the Little Colorado.

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[1] N. Am. Fauna No. 13, p. 53, 1897.

[2] Mammals of Colorado, p. 267, 1906.

[3] Proc. Acad. Nat. Sci. Phila., p. 407, 1908.

[4] Further Notes on Mammals of Colorado, p. 85, 1908.

Nyctinomus depressus Ward. Tacubaya Free-tailed Bat.

Through Mr. E. R. Warren, of Colorado Springs, the Biological Survey has examined a Colorado specimen of this large free-tailed bat. Dr. S. M. Bradbury, of Grand Junction, who owns the specimen, says it was killed by some boys at Grand Junction about 1900. Warren has already placed this specimen on record.[1]

The type locality of *N. depressus* is Tacubaya, Federal District, Mexico. A few individuals have been captured in the desert areas of the southwestern United States, but the Grand Junction record extends the known range of the species far to the east and north.

Antrozous pallidus (LeConte). Pale Bat.

The pale bat occurs in several of the lowest and warmest Upper Sonoran valleys of extreme southwestern Colorado, but has not been reported from north of the Grand River Valley. An extreme record is that of a National Museum specimen taken at Pueblo, east of the mountains, since the species is largely restricted to the desert regions of the Southwest.

An excellent opportunity for observing this species was afforded at Ashbaugh's ranch, in the McElmo Canyon, 20 miles west of Cortez, in June, 1907. At dusk each evening numbers of these large bats appeared about the cliffs immediately north of the ranch, coursing in great circles above the upper rim rock in quest of insect prey. The large size, rapid sailing flight, and slow wing beats made these bats most conspicuous in contrast with the hosts of small *Myotis* and *Pipistrellus* which darted about in the gloaming in jerky, erratic flight. The majority of the pale bats flew so high as to be out of gun range from the base of the cliffs, but I managed to shoot two females on the evening of June 21. These bats were rarely observed about the ranch buildings, and invariably appeared first over the cliffs in the early twilight. Although none were seen actually emerging from the cliffs, the numerous cracks and crevices doubtless formed their retreat during the day.

In the deep canyon of Tabeguache Creek, north of Nucla, Montrose County, six or eight pale bats flew about the cliffs at a considerable height above our camp in the gathering twilight, July 19. They appeared in companies of two and three and coursed about with characteristic steady, rapid flight. I have observed this species at the following two points in the Grand River Valley, a single individual at each locality: In the rock-walled canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County, September 30, 1906; and among the cliffs along Grand River, 7 miles west of Rifle, August 14, 1907. Neither bat was collected, but identification was reasonably positive. A large light-colored bat, apparently *Antrozous*, is commonly reported from the Grand River Valley near Crevasse, Mesa County, where it is said to live in ranch buildings.

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[1] Mammals of Colorado, p. 268, 1906.

The first recorded instance of the capture of *Antrozous* in Colorado is that given by Coues and Yarrow of a specimen taken at Pueblo by W. D. Wheeler in October, 1874, and deposited in the United States National Museum.[1] Dr. F. W. True informs me that this specimen, which appears to have been mummified, was destroyed about 1905, but that the skull is preserved.

Myotis subulatus (Say). Say Bat.

Vespertilio subulatus Say, Long's Exped. to Rocky Mts., II, p. 65, 1823. Type from Arkansas River, near La Junta, Otero County, Colorado.

Warren records two specimens of the Say bat from Colorado Springs.[2] These and the type appear to be the only Colorado specimens of this widely distributed species known at the present time. The species should be present over much of eastern Colorado.

Myotis lucifugus longicrus (True). Long-legged Bat.

This western form of the little brown bat is not uncommon in western and southern Colorado. One shot at Steamboat Springs as it was flying over Bear River at dusk August 1, 1905, is lighter colored than normal *M. longicrus*. Two others in grayish pelage were secured on the White River meadows, a few miles east of Meeker, August 12. At the last locality large numbers of these bats were flying over White River late in the evening. A dark female was collected at Coventry August 1, 1907, in my bedroom at 2 a. m. This form is also represented in the Biological Survey collection by a specimen from Grand Junction, collected June 23, 1893, by Mr. J. Alden Loring; and another collected on Conejos River, west of Antonito, by Mr. James H. Gaut, September 4, 1904.

Three specimens from the eastern part of the San Luis Valley have been identified recently for Warren. Two were collected above Herard, in Madenos Canyon, Saguache County, at an elevation of 8,700 feet, July 12, 1909. A third, from the Medano Springs ranch, east of Mosca, June 22, 1909, has distinct whitish edgings to the uropatagium, and is altogether paler than normal *longicrus*. Young records a mutilated skin in the collection of the Academy of Natural Sciences, Philadelphia,[1] from Eldora, in the high foothills of Boulder County.

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[1] Explorations W. of 100th Meridian, V, p. 85, 1875.

[2] Mammals of Colorado, p. 267, 1906.

Myotis evotis (H. Allen). Long-eared Bat.

The long-eared bat has been taken on both sides of the mountains in the Upper Sonoran zone, and a specimen recently recorded by Mr. R. T. Young from an elevation of nearly 7,000 feet, in the Steamboat Springs region,[1] shows that the species occasionally ranges into the Transition zone.

A series of 11 specimens was collected at the old L7 ranch, a few miles southeast of Sunny Peak, Routt County, in August, 1906. The bats had their abode in the deserted ranch house, and numbers could be seen flying in and out of the open doorway at dusk. I secured the specimens by entering the house after nightfall with a candle. Some were caught with an insect net, while others were knocked down with a hat. The above series presents considerable color variation, due largely to age. Three are immature and in gray pelage, but the majority are light yellowish brown. In 1907 this species was tolerably common at Ashbaugh's ranch, in the McElmo Canyon, Montezuma County, from June 20 to 23, where two were caught in the house after dark. One which flew into a house at Dolores the evening of June 27, I captured with my hand. At Coventry this was the most abundant bat about the ranch buildings in July. Five were caught in a house after dark July 24 as they flew in at the open window, attracted by the light. I have not taken this bat about rocky ledges and cliffs, and it appears to frequent mainly houses and outbuildings. Nearly all the above specimens are females. Specimens from Loveland have been recorded by Miller.[2]

Myotis yumanensis (H. Allen). Fort Yuma Bat.

This pale southwestern species is at present known in Colorado only from western Routt County, but eventually may be found at other points along the western border of the State, in the Upper Sonoran zone. It is represented by two females from Snake River, south of Sunny Peak, August 28, 1906; and a male from near Lily, at the confluence of the Snake and Bear Rivers, September 9, 1906. I secured these bats in deserted ranch buildings after nightfall, where they were not at all common, being greatly outnumbered by *M. evotis*.

The above specimens accord well in color with typical *yumanensis* from Fort Yuma, California, but have a somewhat longer forearm and foot.

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[1] Proc. Acad. Nat. Sci. Phila., p. 408, 1908.

[2] N. Am. Fauna No. 13, p. 80, 1897.

Myotis californicus (Aud. and Bach.). Little California Bat.

This small bat has been taken thus far at several widely separated localities in southern and western Colorado, and east of the mountains is known from two points in the Arkansas Valley and from Boulder Canyon. Its zonal distribution appears to be mainly Upper Sonoran.

In the McElmo Canyon, Montezuma County, it was apparently common in June, 1907, and I shot two at dusk as they were flying about the rocky cliffs north of Ashbaugh's ranch and caught another by lamplight in the house after dark. Another was captured in a house in the Grand Valley near Morris, 7 miles west of Rifle, August 14. An adult male from the San Luis Valley, 7 miles east of Antonito, Conejos County (8,000 feet), September 1, 1904, was taken by Mr. James H. Gaut. Small bats which I saw at Pagosa Springs May 28, 1907, and at the Paradox crossing of Dolores River July 7 were probably *M. californicus.* Specimens in the Warren collection from Bedrock (Montrose County), Salida, and Van Andert's Spring on Little Fountain Creek (El Paso County) have been examined by the Biological Survey.

Specimens of *M. californicus* from the highest elevations—Salida, Van Andert's Spring, Antonito, and Rifle—are almost as dark as typical *californicus.* Others from Ashbaugh's ranch and Bedrock, in the low desert valleys of southwestern Colorado, are considerably paler, agreeing precisely in coloration with specimens in the Biological Survey collection from the deserts of Arizona and Nevada. They are not as pale, however, as *M. c. ciliolabrum.*

Since the above was written Mr. Junius Henderson has written to me as follows: "Two specimens of *Myotis californicus* were taken in Marchioness Tunnel, Boulder Canyon, altitude 6,200 feet, by John J. Blanchard, December 22, 1909, thus making a winter record. I did not see these two bats until some ten minutes, perhaps, after he took them, when one of them was squealing viciously, but the other was quiet. In the warm cabin the former soon began to fly about the room. Supposing the winter habits of the animals here to be well known, Blanchard made no particular examination of them when he found them, but says he believes they were dormant, which is my impression from the condition of one of them when it reached me. The further fact that this tunnel, unlike some, does not seem to be infested with insects or other food for bats would tend to confirm the idea of hibernation. Possibly the temperature may give you some light on that subject. At the breast of the tunnel, where the bats were taken, about 350 feet back into the mountain, the temperature was soon after measured and found to be 46° F."

Myotis californicus ciliolabrum (Merriam). Hairy-lipped Bat.

The only western Colorado specimens of this small pale form of *M. californicus* appear to be two females from the old L7 ranch on Snake River, a few miles southeast of Sunny Peak, Routt County, taken August 28 and 29, 1906. Both the above bats I secured in the deserted ranch buildings after nightfall. This form was uncommon at that locality, being greatly outnumbered by *M. evotis*. In June, 1909, I found the hairy-lipped bat abundant in the badland cliffs at Chimney Canyon, some 30 miles northwest of Sterling. It appeared to be the common bat at this point, outnumbering *Eptesicus*, the only other bat seen, fully 10 to 1. Two were shot as they issued from the cliffs at dusk to feed on insects in the bottom of the canyon.

Pipistrellus hesperus (H. Allen). Western Bat.

These diminutive black-eared bats—the smallest species found in the State—inhabit the Upper Sonoran zone in the western and southwestern valleys. So far as my observations go, they live only about cliffs and in rock-walled canyons, where soon after sunset they issue in large numbers from the rocky ledges, and with rapid, erratic flight dart about in their nightly quest for insects, appearing in the gloaming like large moths. Aside from its small size, *P. hesperus* in flight may be easily distinguished by the very narrow wings.

In the lower McElmo Canyon, Montezuma County, I found this the most numerous species in June, 1907, and it was common also in the canyon of Tabeguache Creek, north of Nucla, Montrose County, in July. One was seen flitting about the cliffs on Grand River, 7 miles west of Rifle, August 14. At early dawn, October 1, 1906, a very small bat, which I took to be this species, flew over our camp beneath the steep cliffs in the canyon of Plateau Creek, 5 miles east of Tunnel, Mesa County.

There are seven Colorado specimens of *P. hesperus* in the Biological Survey collection, all females: One each from Ashbaugh's ranch (near McElmo), June 21, and Tabeguache Creek, July 19, 1907; four from Grand Junction, June 22 and 23, 1893; and another from Rifle, August 25, 1908. Warren has this bat from Bedrock, Montrose County.

Eptesicus fuscus (Beauvois). Brown Bat.

The common brown bat has a wide distribution and probably occurs over the whole State, except in the higher mountains above the Transition zone. One was shot near Steamboat Springs, Routt County, in August, 1905, as it was flying over Bear River; while later in the same month another was secured on White River, a few miles east of Meeker, Rio Blanco County. Bats which appeared to be *fuscus* were seen flying in McElmo Canyon, Montezuma County, in June, 1907, and others over the Dolores River in Paradox Valley, July 7.

This bat has been recorded by Miller from Loveland,[1] and by Allen from Florida, La Plata County.[2] According to Warren, Mr. A. E. Beardsley reports it common at Greeley.[3] More recently Warren mentions taking a specimen at Douglas Spring, Routt County, 1 at Colorado Springs, and 21 at Newcastle, and says: "Only one of the brown bats [Newcastle series] was a male, all the rest being females, one of the latter having a small young one attached to a teat. This was on July 16, 1907. The Douglas Spring specimen, taken June 26, contained a single good-sized embryo."[4] *E. fuscus* has also been taken in Boulder Canyon, at about 7,000 feet, according to Young.[5] All the above localities are in the Upper Sonoran zone or in the Transition zone.

Considerable color variation is shown by specimens of *E. fuscus* from different parts of Colorado, some being as dark as normal and others much paler. A specimen in the Biological Survey collection from the Chimney Bluffs, some 30 miles northwest of Sterling (June 7, 1909), is the only one examined, however, which shows a near approach to the extremely pale coloration of *E. f. pallidus*. Although nearly as pale as *pallidus*, this specimen has the measurements of *fuscus*, to which it is referred. Another specimen from Steamboat Springs has the dark coloration of *fuscus*, but in large size approaches *pallidus*.

Eptesicus fuscus pallidus Young. Pale Brown Bat.

Eptesicus pallidus Young, Proc. Acad. Nat. Sci. Phila., p. 408, 1908. Type from Boulder, Colorado.

The exact status of this peculiar large pale bat will not be known until much additional material is received from the plains region of eastern Colorado. The type from Boulder in the National Museum is larger than *fuscus*, and is very pale. It measures: Total length, 127; tail, 50; hind foot, 12. Other specimens from Boulder, the measurements of which are given in the original description (l. c.), are nearly as large as the type. The skull of the type is like that of *fuscus*, only larger, being about the size of *E. miradorensis*. The type of *pallidus* can be closely matched in size by a dark specimen of *fuscus* from Steamboat Springs, and in pallid coloration by a smaller individual from the Chimney Cliffs, northwest of Sterling.

Mr. Junius Henderson, curator of the museum of the University of Colorado at Boulder, writes me of the recent capture of three additional specimens of *E. f. pallidus* at Boulder. Warren, who has examined these bats, says that they are paler than his specimens of *E. fuscus* and agree in measurements with the type of *pallidus*.

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[1] N. Am. Fauna No. 13, p. 98, 1897.

[2] Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

[3] Mammals of Colorado, p. 268, 1906.

[4] Further Notes on Mammals of Colorado, p. 85, 1908.

[5] Proc. Acad. Nat. Sci. Phila., p. 409, 1908 (footnote).

Lasionycteris noctivagans (LeConte). Silver-haired Bat.

During the breeding season the silver-haired bat is probably restricted largely to the Canadian zone in Colorado, as it is elsewhere in North America, but specimens taken in both the Transition and the Upper Sonoran zones indicate that at certain seasons it performs vertical migrations of some extent.

One evening in August, 1905, while encamped at the Widows Corral, on the White River Plateau, 25 miles southeast of Meeker, I obtained frequent glimpses of a small bat flitting about in the aspen forest. It flew so near the ground that its course was very difficult to follow in the fast-gathering twilight, but it was shot and proved to be a specimen of the silver-haired bat. This locality is in the Canadian zone, at 8,500 feet. The Biological Survey has a specimen of this bat from Rifle, Garfield County, collected by Loring in 1893; while a specimen taken by Dr. Elliott Coues in North Park at 10,000 feet, September 16, 1876, is in the National Museum.

Warren has specimens from Green Mountain Falls, Newcastle, and Salida, and records the species from Glen Eyrie (near Colorado Springs) and Greeley.[1]

Mr. Junius Henderson informs me by letter of the capture of a specimen at Boulder June 6, 1909.

I did not meet with this bat in southern Colorado, but it has been recorded from Florida, La Plata County, where Charles P. Rowley collected two specimens in 1892.[2]

Nycteris cinereus (Beauvois). Hoary Bat.

The large hoary bat has been taken only a few times in the State, and consequently its local distribution is not well known. The normal breeding range is in the Canadian zone, and therefore it may be expected to breed in the mountains. Thus far, however, specimens have been collected only in the eastern foothills and along their immediate eastern bases and in the lower valley of Grand River. A mounted specimen owned by Dr. S. M. Bradbury, of Grand Junction, taken at that locality, has been examined, and there is a specimen in the Merriam collection from Boulder County, secured by the late Mr. Denis Gale September 16, 1889. Miller records three specimens from Larimer County.[3] Warren quotes the statement of Mr. A. E. Beardsley that this bat is "frequent at Greeley,"[4] and states in a recent letter that it has been taken at Salida and Boulder.

Nycteris borealis (Müller). Red Bat.

Biological Survey collectors have not met with this species in Colorado, although it should be found over the eastern plains region. The only record seems to be that of Mr. A. E. Beardsley, who says the red bat is rare at Greeley.[5]

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[1] The Mammals of Colorado, p. 277, 1910.

[2] Allen, Bull. Am. Mus. Nat. Hist., V, p. 83, 1893.

[3] N. Am. Fauna No. 13, p. 114, 1897.

[4] Mammals of Colorado, p. 268, 1906.

[5] Warren, Mammals of Colorado, p. 268, 1906.

PRINCIPAL TREES AND SHRUBS OF COLORADO.

The explorations of the Biological Survey in Colorado have resulted in the accumulation of valuable notes on the distribution of many species of plants, and those relating to the trees and shrubs are brought together in the following briefly annotated list. No attempt is made to give a complete list of Colorado trees and shrubs, and the species included are chiefly those whose known ranges in the State have been considerably extended by the work of the Biological Survey. Several of these apparently have not been recorded previously from the State. Most of the specimens collected have been identified by the botanists of the United States National Museum.

The nomenclature followed is mainly that of Dr. Rydberg in his Flora of Colorado (Bull. 100, Colo. Agr. Exper. Station, 1906). Distribution notes relative to a number of species of restricted range are taken from this publication and, to avoid repetition, are unaccompanied by references.

Pinus aristata. Foxtail Pine.

The foxtail pine is a characteristic timberline tree on parts of the Front, Kenosha, Saguache, and Sangre de Cristo Ranges, but was not observed on the mountains of western or extreme northern Colorado. On the Sangre de Cristo Range the southern limit appears to be near Crestone Peak, but I again encountered it on the high Culebra Range southwest of La Veta. On the Saguache Range it was found south to a point northwest of Villa Grove, and scattering trees were observed at timberline on the San Juan Mountains northeast of Pagosa Springs. None of these pines were seen on the Front Range north of James Peak. Foxtail pines are most abundant on the Saguache Range near St. Elmo and in the Grays Peak region. A straggling and dwarfed growth fringes the exposed ridges on both sides of Clear Creek Valley above Silver Plume, between 11,000 and 11,500 feet.

Although largely confined to the timberline region between 11,000 and 12,000 feet, and perhaps more nearly restricted to the Hudsonian zone than any other tree in the State, the foxtail pine is occasionally found on bare exposed ridges as low as 9,500 feet. Near Como it is common on many of the ridges bordering South Park at 10,000 feet. Between Clyde Station and Cheyenne Mountain on the Cripple Creek Short Line Railway the species forms a considerable forest. At this point the pines are very regular in shape, few are branched near the base, and many are 30 feet high. In the timberline region the trees are usually under 15 feet in height, dwarfed and ragged, and the majority are much branched. (See Pl. XI, fig. 1.) At a distance they greatly resemble a ragged growth of juniper (*Juniperus monosperma*), and are in marked contrast to the more symmetrical Engelmann spruces, which usually share the bleak timberline slopes with them. Foxtail pines usually grow on slopes having warm south or west exposures and very rarely on cool slopes. This species forms the highest recorded timberline in the State (12,300 feet), near St. Elmo, on the Saguache Range.

Pinus flexilis. Rocky Mountain White Pine.

This small, bushy, much branched pine has a general but very scattering distribution in the mountains of northern Colorado, at elevations between 7,000 and 10,000 feet. Like the foxtail pine of the timberline regions, which it greatly resembles, *P. flexilis* usually grows along the crest of bare, outlying, gravelly ridges, and owing to its wind-swept location usually grows straggling and one-sided. It is most abundant on the open mountain slopes east of Fall River, Clear Creek County, on the ridges of the South Park region, and on the mountains east of Laramie River, but was noted at other localities as follows: McIntyre Creek, east slope of Medicine Bow Range; outlying ridges north of Higho and east of Canadian Creek, North Park; Hahns Peak (8,500 feet); bluffs north of Snake River, 8 miles east of Slater; Grand River Canyon, east of Glenwood Springs; Empire; canyon on Grand River, west of Hot Sulphur; and valley of South Boulder Creek. The species does not attain its maximum size in northern Colorado, and no trees more than 30 feet high were observed.

P. flexilis was found at but few localities in the southern mountains in 1907. Groves of considerable extent are on the partially open slopes at the head of Wahatoye Creek, between the Spanish Peaks and the Culebra Range, at about 9,000 feet elevation, and the species is common throughout the La Veta region. A much larger growth is attained here than farther north, many of the trees reaching a height of 50 feet. This pine is not uncommon at Pagosa Springs, between Needleton and Silverton, on the Rio Grande bluffs below Wagon Wheel Gap, and at Divide.

Pinus scopulorum. Rocky Mountain Yellow Pine.

The yellow pine is a characteristic tree in the foothills of all parts except northwestern Colorado. The eastern foothills of the Medicine Bow and Front Ranges are clothed with a scattering growth from their bases to the lower edge of the lodgepole pines at 8,000 or 9,000 feet, the heaviest forests being west of Loveland, on the western end of the Arkansas Divide, and in the South Platte region. Farther south there is a good stand on the Wet Mountains, becoming heaviest in northwestern Huerfano County and continuing southward in a well-defined belt along the eastern foothills of the Sangre de Cristo and Culebra Ranges. On the lower mountain slopes bordering San Luis Valley the pines are restricted to narrow interrupted belts, which converge at its northern end and connect over Poncha Pass with the pine country along the Upper Arkansas.

West of the Continental Divide, *P. scopulorum* is largely restricted to the region south of the Grand and Gunnison Rivers. Stately forests of great extent occupy the southern and western slopes of the San Juan, La Plata, and San Miguel Mountains, and the eastern slopes of the La Sal Mountains, ranging between 6,500 and 8,500 feet, and a moderately heavy growth extends to the northwestern end of the Uncompahgre Plateau. In the Gunnison country yellow pines are very local and scattering, except in the valley of the Lake Fork, where they are tolerably common. In northwestern Colorado they are rarely seen, and occur in widely separated areas of small extent as follows: Medicine Bow Mountains, east of Canadian Creek, North Park, lowest outlying spurs, 8,800 feet; north slope of Elk Head Mountains, 20 miles southeast of Slater, rocky exposed ridges, 7,800 feet; Grand River Canyon to 6 miles west of Glenwood Springs; southwest slope 8 miles north of McCoy, Eagle County, 7,800 feet; and on the summits and northern slopes of the Escalante Hills, in western Routt County, where there is a tolerably heavy growth between 6,400 and 7,500 feet.

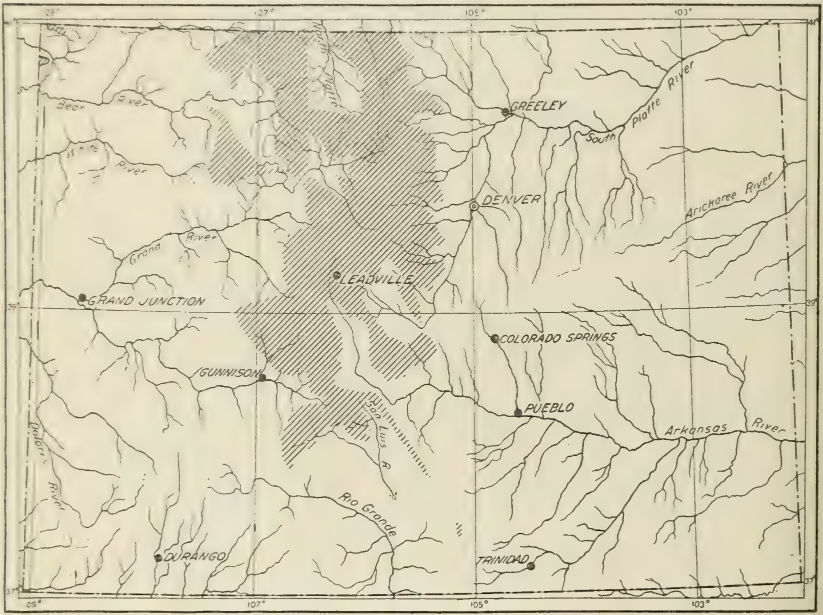
107°
105°
103°
Bear River
White River
GREELEY
South Platte River
DENVER
Arickaree River
Grand River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD
39°
37°

FIG. 30.—Distribution in Colorado of lodgepole pine (*Pinus murrayana*).

In the eastern and northern mountains the yellow pines seldom attain large size, and in rocky situations they are often quite scrubby. In the southwest, however, particularly in Archuleta County, there are as large trees and handsome forests as can be found in any of the Rocky Mountain States. Lumbermen have exhausted some of the best pine forests of southwestern Colorado, but there still remain large areas, and fortunately these are now largely included in the San Juan and Montezuma National Forests.

Pinus murrayana. Lodgepole Pine.

A broad belt of magnificent lodgepole pine forest with a vertical breadth averaging 2,000 feet occupies the middle slopes of the high mountain ranges of northern Colorado between 8,000 and 10,000 feet. (See fig. 30.) This forest clothes the summits of the Laramie Divide and of the lower parts of the Medicine Bow, Park, and Gore Ranges. Farther south this pine covers an extensive area on the Saguache Range and on the mountains of the Gunnison country. The southern limit is reached on the Continental Divide at the head of the Saguache River. On the Sangre de Cristo Range a narrow belt extends south along the eastern slope as far as Crestone Peak, but the species appears to be entirely absent from the western slope of the same range. A few of these pines are found on the summit of Veta Pass—the southernmost point at which the species is known to occur within the State.

The heaviest and purest forests of lodgepole pines were traversed on the high divide east of Laramie River and on the Park and Gore Ranges, at an elevation of about 9,500 feet. (See fig. 31.) On most of the ranges, however, the pines are mixed with aspens below 9,500 feet and with Engelmann spruces above 10,000 feet.

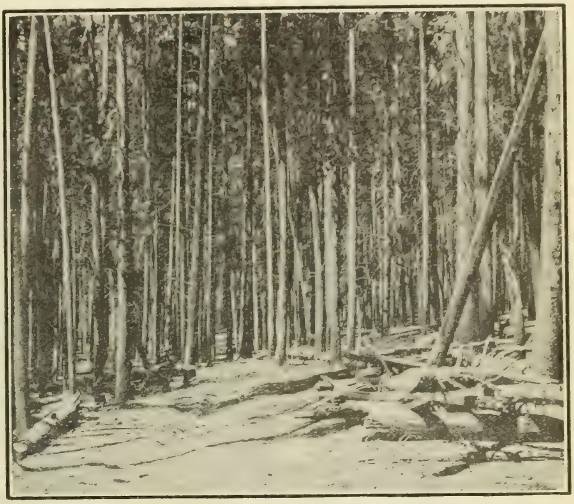

Fig. 31.—Forest of lodgepole pines (*Pinus murrayana*), eastern slope of Park Range, west of Pearl, at 10,000 feet.

To the west *P. murrayana* is the common forest tree in the Elk Head Mountains and in the region bordering Egeria Park, but on the White River Plateau it does not extend far west of the South Fork of White River. A scattering growth is reported on Diamond Peak and Mount Cullom, on opposite sides of Green River in extreme northwestern Routt County. The lowest elevation reached within the State appears to be on the northern slope of the Elk Head Mountains near Honnold, where narrow tongues descend to the bank of

Snake River at 7,000 feet. The extreme upper limit on the Boreas Pass is on a southwest slope at a little over 11,000 feet. This pine appears to be absent from the mountains of southwestern Colorado.

The lodgepole pine is very largely restricted to the Canadian zone. In the mountain districts of central Colorado much of the best growth has been used for mining timbers, and farther north lumbering operations have depleted large tracts. At present a young and dense growth covers much of these areas, which are practically all included in National Forests.

Pinus edulis. Pinyon; Nut Pine.

The pinyon is found in abundance in the rough country of western and southern Colorado at elevations varying from 5,000 to 7,500 feet. It clothes the rocky slopes and bluffs bordering the river valleys and forms a dense growth on most of the rough intervening watersheds and mesas. In the mountains of the San Luis Valley region the pinyon belt reaches an elevation of 9,000 feet on warm slopes.

This small pine is fully as common in the Upper Sonoran zone as *Juniperus monosperma*, and marks this zone over extensive areas. In many localities, however, it enters the lower edge of the Transition zone, where it commingles to a certain extent with yellow pines and Douglas spruces. It is nearly always associated with the juniper (*Juniperus monosperma*) below 7,000 feet.

A very dense growth of pinyon covers the Mesa Verde and practically all the broken country from Montezuma County north to Mesa County. A heavy and continuous belt is found on the lowest flanks of all the mountains from the San Juans north to the Book Cliffs, and in the Grand River Valley the species extends eastward as far as McCoy, Eagle County. North of the Book Cliffs the distribution is more restricted, as follows: Evacuation Creek Valley up to 7,000 feet on north slope of the Book Cliffs; heavy growth in Pinyon Valley and on the Rabbit Hills; divide between Bear and White Rivers, south of Lily, to 6,000 feet; Escalante Hills, dense growth on north slopes at 6,400 to 7,000 feet; scattering growth southwest slope of Cross Mountain, and also on south slope of O-wi-yu-kuts Plateau. Pinyons are found on most of the mesas and ridges of the San Luis Valley region, and form heavy belts on the lower bordering mountain slopes north as far as Villa Grove. On the eastern slope of the mountains they occur regularly north to Manitou, and follow up the warm Arkansas Valley to considerably above Buena Vista, the growth being especially dense and extensive on the head of Huerfano River and in the adjacent country. The species reaches its eastern limit in Colorado, and probably in the United States, in Las Animas County, where a considerable growth is found on Mesa de Maya and on other high points in that rough region.

Picea engelmanni. Engelmann Spruce; White Spruce.

The stately Engelmann spruce forms a heavy forest belt just below timberline on all the higher mountain ranges, and in a dwarfed state is common at timberline. At this elevation it occurs in prostrate mats 1 to 3 feet in height and often 8 or 10 feet in diameter. Its greatest development is reached along the upper edge of the Canadian zone, where the spruce forest is either pure or mixed with balsam firs, many of the trees being 3 or 4 feet in diameter and 100 feet in height.

The heaviest spruce forests were on the Park, Medicine Bow, and Saguache Ranges, in the San Juan Mountains, and on both slopes of the Front Range from Rollins Pass south to Berthoud Pass. A moderate growth of Engelmann spruce is found on the Uncompahgre and White River Plateaus, on Grand Mesa, and on other high plateaus of western Colorado.

The upper limit of the Engelmann spruce varies with timberline from 11,000 to 12,000 feet. The vertical width of the belt depends much upon the steepness of slope, averaging between 1,000 and 1,500 feet on gradual slopes, but often narrowing to 500 feet, as is the case just below timberline on a steep southwest exposure south of Berthoud Pass. Below 10,000 feet *P. engelmanni* occurs only in damp situations on cold slopes and in descending tongues along streams, usually embraced by heavy forests of lodgepole pine or aspen. It is found as low as 8,200 feet along Pass Creek, on the eastern slope of the Park Range; while on the mountains east of Laramie River it occurs at 8,500 feet. Scattering trees occur on Middle Boulder Creek, 5 miles west of Boulder, at 6,000 feet, but this low elevation is abnormal.

Picea parryana. Blue Spruce.

The blue spruce has a very scattering distribution in the lower part of the Canadian zone on both slopes of the main ranges. In northern Colorado in 1905 and 1906 small clumps and single trees were noted here and there along streams at elevations of from 7,000 to 8,500 feet, as follows: West of Log Cabin, Larimer County, 7,500 feet; Nederland, 8,200 feet; South Boulder Creek; northeast base of Floyd Hill; Empire; Idaho Springs; Fall River, Clear Creek County; south slope of Park Range; north of Hahns Peak, 8,500 feet; Snake River bluffs; Honnold to 8 miles east of Slater; north slope of Piney Divide, south of McCoy, 7,500 to 8,000 feet; Pass Creek, northwest of Kremmling; Eagle River, Dotsero to Wolcott; and canyon of the Grand east of Glenwood Springs. In the mountains of southern Colorado the blue spruce has a general distribution between 8,500 and 9,500 feet, being much more common than farther north.

This species is apparently never found away from the immediate vicinity of streams,[1] all the trees that I have observed growing either on the banks of watercourses or on the nearest benches. It probably belongs to the Canadian zone, but in common with many other boreal species finds a suitable environment in the cool conditions which obtain along streams well down into the Transition zone. The characteristic scattering distribution of the blue spruce along watercourses is best seen along Eagle River between Wolcott and Dotsero, on the Frying Pan River, and on the many streams of Clear Creek County.

Pseudotsuga mucronata. Douglas Spruce; Red Fir.

The Douglas spruce is of comparatively small size in Colorado. The largest trees are found along watercourses, where a height of 100 feet and a diameter of 3 or 4 feet are occasionally attained. The average growth, however, is less than a third of these dimensions, especially among the eastern foothills.

The species has a general distribution in the mountain districts, being most abundant on the eastern slopes of the Medicine Bow and Front Ranges and on the plateaus and higher mesas of western Colorado. It is mainly a Transition zone tree, but occurs commonly in the lower Canadian zone also, particularly in the western mountains.

On the eastern slopes of the main ranges the Douglas spruce is occasionally found along streams as low as 5,800 feet. In the upper part of the yellow pine belt it occupies most of the steep north slopes between 6,000 and 8,000 feet. Near Fall River, in Clear Creek County, it extends up southwest slopes to the 9,000-foot summits of hills, whose northeast exposures are clothed with lodgepole pines and aspens. The Douglas spruce thus occupies a position intermediate between the yellow and lodgepole pine belts east of the Continental Divide. Over most of western Colorado it is found just above the pinyon belt, largely replacing the yellow pine in the Transition zone, and with the aspen clothing the Canadian zone summits and upper northern slopes of the plateaus and higher mesas. (See fig. 32.) On the crest of the Uncompahgre Plateau and elsewhere it grows at an elevation of over 10,000 feet.

The following localities indicate the distribution of *Pseudotsuga* in northwestern Colorado: North slope of Piney Divide, south of McCoy, 7,000 to 8,000 feet; south slopes of mountains north of McCoy, 8,000 to 8,500 feet; mountains south of Eagle; canyon of the Grand above Glenwood Springs; Battlement Mesa; Great Hog Back;

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[1] At Saguache and elsewhere these handsome spruces grace many dooryards, where they have been planted. As an ornamental tree the blue spruce has few equals.

southern slopes of White River Plateau; Grand Mesa; high country on both sides of Grand River between Glenwood Springs and Grand Junction, at elevations ranging from above 6,000 feet on cold slopes to 7,000 or 8,000 feet on warm slopes; Book Cliffs, heavy growth on north slope near Baxter Pass, 7,000 to 8,500 feet; hills bordering Evacuation Creek Valley; sparse growth on northeast upper slopes of Rabbit Hills; and Zenobia Peak, scattering growth reported. In southwestern Colorado I observed the species as follows: Southern slopes of La Plata Mountains between Durango and Mancos in the Canadian zone; upper slopes of Ute Peak; steep upper rims of Sinbad and West Paradox Valleys (cool exposures); Unaweep Canyon; Cimarron; Vernal Mesa; West Elk Mountains east of Crawford; Roaring Fork of Grand River, Basalt to Aspen; Sapinero; and Lake City.

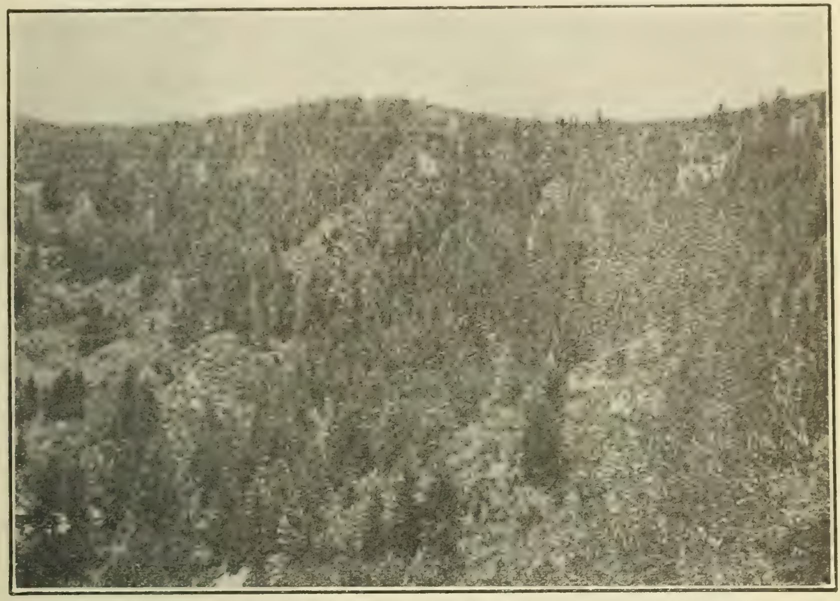

FIG. 32.—Pocket of Douglas spruce (*Pseudotsuga mucronata*) on northern escarpment of Mesa Verde, 7,500 to 8,000 feet.

Abies lasiocarpa. Balsam Fir.

The balsam fir is found throughout the Hudsonian zone and along the upper edge of the Canadian zone. It is not so uniformly distributed as the Engelmann spruce and does not form as extensive forests. Occasionally, however, its growth is heavy, as on the western slope of the Front Range in the vicinity of Rollins Pass and on the west side of the Saguache Range below Alpine Tunnel, where extensive forests were traversed between 10,000 and 11,000 feet.

In a dwarfed state this fir often extends up to extreme timberline with the Engelmann spruce. Its characteristic growth is in clumps and thickets scattered here and there through the spruce forest, and the smooth, light-colored trunks of the firs are very conspicuous among the dark spruces. Occasionally the species is encountered as low as 8,500 feet, and on the eastern slope of the Park Range northwest of Kremmling I found it growing along streams at 8,200 feet. It formed heavy thickets at 10,000 feet on the divide east of the Laramie River, and also on the Medicine Bow Range; and on the northern part of the Park Range it was common both on the Buffalo Pass and on the headwaters of Grand Encampment River. On the White River Plateau it was growing in dense thickets in the aspen forests between 8,500 and 9,000 feet, chiefly on northern exposures.

This tree appears to have fully as wide a range in southern as in northern Colorado, but the growth is smaller and more scattered toward the south. The species was observed in southern Colorado on the summit of the Uncompahgre Plateau, at Rico and Ophir, from Needleton to Silverton, and between Vance Junction and Sawpit.

Abies concolor. White Fir.

The white fir is found in the southern mountains, where it is usually common between 8,500 and 10,000 feet, in the lower Canadian zone. It does not occur far north of Colorado Springs on the eastern slope, and Ouray marks the northern limit west of the Continental Divide. The white fir forms considerable forests in the Wet Mountains and on the southern slopes of the San Juan Mountains north of Pagosa Springs, but usually the growth is somewhat scattering, and is restricted either to the vicinity of streams or to cool exposures, where the firs mingle with aspens. The largest trees observed were at 9,000 feet on the southwest slope of Pagosa Peak, where a height of 75 feet was not uncommon.

The white fir was noted at the following localities: Wet Mountains, east of Westcliffe, 9,000 feet; mountains between Canon City and Cripple Creek, above 8,500 feet; northern exposures on eastern slope of Sangre de Cristo Range near Sand Hill Pass, 9,000 to 9,500 feet; head of Wahatoye Creek, 9,000 feet; upper northern slope of Fisher Peak, south of Trinidad; mountains near Saguache; Animas Canyon, near Silverton; and lower mountain slopes surrounding Ouray.

Juniperus scopulorum. Rocky Mountain Juniper.

This juniper is common in the Upper Sonoran and Transition zones throughout the mountains, and also often forms the only coniferous growth in gulches and on rocky ridges and buttes on the higher plains of northeastern Colorado. It has an extreme vertical range within the State from 4,500 to 10,000 feet, and is most abundant in the higher foothills between 6,000 and 8,000 feet. I observed it at the following localities: Boulder; Golden; Platte Canyon Station; Pawnee Buttes; Bailey; Colorado Springs; La Veta; hills north of Canon City; Promontory Bluffs; bluffs east of Grover; Buena Vista; St. Elmo; Weston; Chimney Cliffs, northwestern Logan County; Book Plateau, sparingly above 7,500 feet; Glenwood Springs; Wolcott; McCoy; Ohio City; Gunnison; Sapinero; Lake City; Lone Cone; Beaver Mountain, Dolores County; Mancos; Mesa Verde, north escarpment; and Pagosa Springs.

Juniperus monosperma. Juniper.

This is the most abundant juniper in the State, and is a characteristic Upper Sonoran species. It forms a well-defined belt covering most of the lowest foothill slopes of western and southern Colorado and is prominent on the eastern foothills from the Arkansas Valley southward. A heavy growth covers a large area of rough canyon country in Las Animas and western Baca Counties, and many outlying ridges and buttes in Otero County are clothed with junipers. The species reaches a large size and dense stand on the Escalante Hills and other low elevations of western Routt County, and is abundant on Mesa Verde, in Montezuma County.

The vertical position of *J. monosperma* is immediately below the pinyon belt, although scattering junipers occur with the pinyons as high as 7,500 feet in southern Colorado. It is most abundant between 5,000 and 7,000 feet on arid slopes. The resinous one-seeded berries of this juniper are much used as food by chipmunks, wood rats, and other small rodents.

During my explorations in Colorado I have observed the species as follows: Slater; bluffs bordering lower Snake River Valley; Godiva Ridge; Cross Mountain; Escalante Hills; O-wi-yu-kuts Plateau, southern slopes; Vermilion Bluffs; watershed between Bear and White Rivers south of Lily; 5 miles southwest of Rangely to base of Rabbit Hills; northern and southern slopes of Book Plateau below 7,500 feet; hills south of Mack, Mesa County; lower slopes of Grand Mesa; northeast slope of Little Book Cliffs; De Beque to Glenwood Springs; bluffs along north side of Eagle River from Dotsero nearly to Wolcott; McCoy; Basalt; Somerset; Ridgway; Coventry; Placerville; western Montrose and San Miguel Counties; Mesa Verde; McElmo Valley; Salida; Canon City; Walsenburg; Pueblo; and Gaume's ranch, northwestern Baca County.

Juniperus sibirica. Low Mountain Juniper.

This beautiful procumbent shrub is conspicuous among the undergrowth of the forests in the Canadian and upper Transition zones, where it is almost omnipresent. It reaches its greatest abundance along the upper edge of the yellow pine belt at 8,500 or 9,000 feet. I have found it particularly common in the higher eastern foothills of the Front Range; on the forested ridges near Como, South Park; in the Wet Mountains east of Westcliffe; on the Sangre de Cristo Range in western Huerfano County; and at St. Elmo, Saguache Range, 10,000 feet.

Juniperus prostrata. Creeping Juniper.

The creeping juniper or savin appears to be uncommon in the Colorado mountains. I collected it on Lone Mesa, Dolores County, at 9,200 feet, June 26, 1907; and saw dense patches of it on open rocky ridges along Pass Creek, northwest of Kremmling, Middle Park, in October, 1906. Rydberg records it from North Cheyenne Canyon, Parlin, and Owl Canyon.

Ephedra antisyphylitica. Joint Fir.

The joint fir is a characteristic shrub on the warm rocky Upper Sonoran slopes of western Colorado, extending eastward with the junipers and pinyons for some distance into the mountains along the warm north sides of the river valleys. *E. antisyphylitica* is the common species of widest range, but two other forms are present in the southwestern valleys.

I have observed this joint fir at the following localities: Escalante Hills, 7,000 feet; White River bluffs east of Rangely; pinyon country southwest of Rangely; juniper-covered hills at north base of the Book Cliffs; Glenwood Springs; Basalt; Mesa Verde; McElmo; lower San Miguel and Dolores River regions (omnipresent below 7,000 feet); Placerville; and Coventry.

Ephedra torreyana.

I have taken this species only on the warm juniper slopes along the north side of North Gunnison River at Somerset, 6,000 feet. It is recorded by Rydberg from Deer Run, Mesa County.

Yucca glauca. Yucca.

This yucca is one of the most characteristic Upper Sonoran plants in the State, being almost omnipresent below 6,000 feet, and extending often to 8,000 feet on exceptionally warm slopes in the foothills. It occurs in abundance on both sides of the mountains (see fig. 33), but the densest growth is on the eastern plains, particularly in the southeastern counties. The tall spikes of greenish white flowers are very prominent on the plains during June.

Following are some of the localities at which *Yucca glauca* was observed on my trips over the State: Gaume's ranch, northwest Baca County; Limon; Cheyenne Wells; Tuttle; Wray; Sterling; Pawnee Buttes; Grover; east of Boulder; near Fort Collins; Bailey; Gardner; La Veta; Buena Vista; Wet Mountain Valley; Poncha Pass, summit; Salida; Cascade; Pueblo to Walsenburg; Saguache and San Luis Valleys generally; Gunnison; Hotchkiss; Montrose region; Placerville; McElmo Valley; lower Dolores River region up to 7,000 feet; Unaweep Canyon; Rifle; De Beque; Plateau Creek; and hills between Carbonera and Mack.

Yucca harrimaniæ. Harriman Yucca.

Locally common at several points in the juniper belt of southwestern Colorado below 7,000 feet. I found it in 1907 near Ridgway; on the slopes of Cerro Ridge east of Montrose; and on the rocky slopes along the west side of Sinbad Valley. Rydberg records the species from Cimarron and Durango.

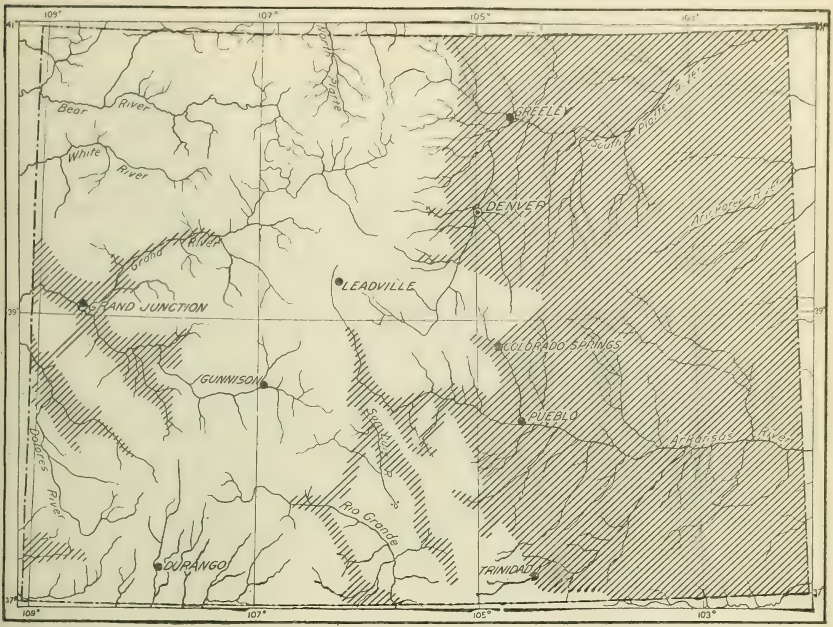
109°
107°
105°
103°
39°
37°
Bear River
White River
Grand River
North Platte
South Platte
Arikaree River
GREELEY
DENVER
LEADVILLE
GRAND JUNCTION
GUNNISON
COLORADO SPRINGS
PUEBLO
Arkansas River
Rio Grande
Dolores River
DURANGO
TRINIDAD

FIG. 33.—Distribution in Colorado of common yucca (*Yucca glauca*).

Yucca baccata. Spanish Bayonet.

This large-leaved yucca is a characteristic Upper Sonoran plant in parts of southwestern Colorado, growing chiefly among rocks on warm juniper slopes and in the lowest valleys. It was flowering on Mesa Verde at 7,000 feet June 13, 1907, the spikes of large greenish white flowers dotting the rocky rims of Navajo Canyon just above the Spruce Tree Cliff Ruins. (See fig. 34.) I observed this yucca at Arboles; Bayfield; McElmo; Coventry; on slopes bordering Paradox and Sinbad Valleys; and along the canyon of Dolores River between Salt Canyon and the mouth of West Creek. There appears to be only one Colorado record for *Y. baccata* east of the mountains—Rydberg recording it from Trinidad.

Populus tremuloides. Aspen; Poplar.

Extensive aspen forests clothe the summits and northern slopes of nearly all the western plateaus and mountains between 8,000 and 10,000 feet, but on the eastern slope of the main ranges the trees are usually small, and form dense thickets rather than open forests. This boreal poplar is restricted to the Canadian zone, the center of abundance being at about 9,000 feet. Small thickets sometimes occur on cold northeast slopes as low as 7,000 feet, while on warm southern slopes a dwarfed growth usually extends to at least 10,500 feet. The best aspen forests were encountered on the White River, Book, and Uncompahgre Plateaus, and on the north slope of the Rabbit Ear Mountains near Arapahoe Pass, where trees fully 2 feet in diameter and 50 feet in height were not at all uncommon. On the crest of the Uncompahgre Plateau, near its northern end, beautiful aspen groves alternate with reaches of open grassy country, the coniferous element so common elsewhere being very largely absent. The aspen forest is often tolerably clear of large undergrowth, but is mixed here and there with thickets of balsam firs or lodgepole pines. Throughout the mountains are areas which formerly supported coniferous forests, but have been devastated by forest fires.

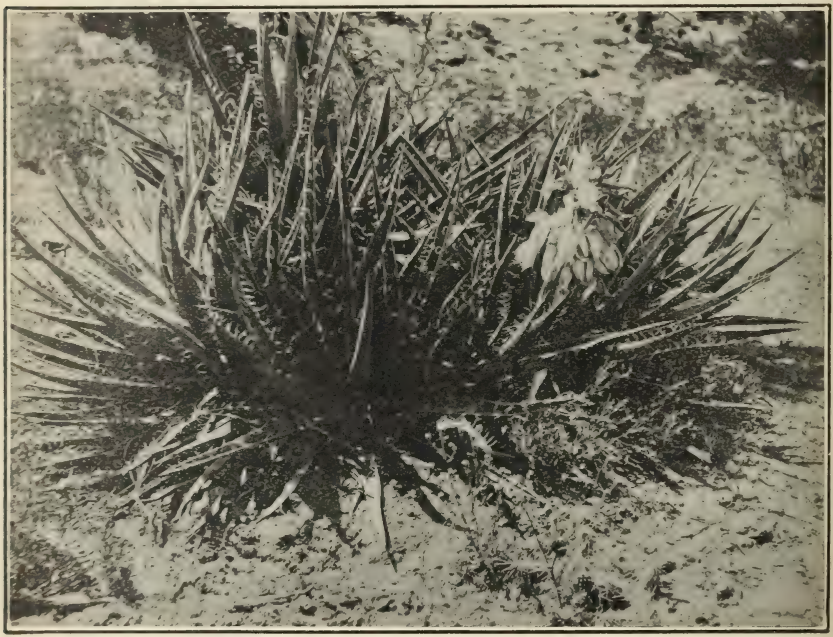

FIG. 34.—*Yucca baccata* in flower, Navajo Canyon, Mesa Verde.

These are now mostly covered with a young growth of aspens, which seem to secure a foothold much more quickly than any of the conifers.

Populus angustifolia. Narrow-leaf Cottonwood.

There is scarcely a foothill stream in the State which is not fringed with more or less of these cottonwoods. It is a characteristic Transition zone species, with a vertical range from 5,500 to about 9,000 feet. Its vertical position is intermediate between the aspen of the Canadian zone and the broad-leaved cottonwoods of the Upper Sonoran zone. It attains its largest size along the lower edge of its range at the base of the foothills, where it often mingles for a short distance with the broad-leaved species. Scattered clumps of large size are found the entire length of the Snake River Valley, in northwestern Colorado.

Populus occidentalis. Broad-leaf Cottonwood.

This is the cottonwood which fringes most of the streams on the eastern plains, the heaviest and largest growth being found along the Platte and Arkansas Rivers and on many of the streams near the base of the foothills from Denver north to Fort Collins. The growth is particularly large in the Arkansas Valley between Las Animas and the Kansas boundary. It is found on only a few streams in the foothills, but near Livermore, Larimer County, I found it up to 6,000 feet along Lone Pine Creek, and a single tree was growing on Middle Boulder Creek at 5,800 feet. On the dry plains of Baca County the beds of the streams, few of which are perennial, are fringed by a gnarled and stunted growth of cottonwoods.

Populus wislizeni. Southwestern Cottonwood.

This is the predominant broad-leaved cottonwood of southwestern Colorado, where it occurs along most of the watercourses below 6,000 feet. I found it common at Arboles; Grand Junction; along McElmo Creek; on San Miguel River below Naturita; Dolores River between Paradox Valley and the mouth of West Creek; Smith Fork below Crawford; and North Gunnison River to 5 miles below Somerset; and it was probably the species growing along the Rio Grande at Alamosa. East of the mountains it is found on the plains at Colorado Springs, according to Rydberg.

Populus acuminata. Smooth-bark Cottonwood.

During my explorations in Colorado I observed this cottonwood only in the Upper Sonoran stream valleys of the northwestern counties from the Wyoming boundary south to Mesa County, as follows: Scattering fringe along Snake River for 8 miles above Lily; dense growth of large size on Green River from Browns Park to northern end of Ladore Canyon; lower Vermilion Creek, western Routt County; scattering fringe along White River from Utah boundary east to Angora; Plateau Creek, Mesa County; and Dolores River, at the mouth of West Creek (growing with *P. wislizeni*). This cottonwood occurs east of the mountains, as Rydberg records it from Fort Collins, Denver, and Walsenburg.

Salix amygdaloides. Peach-leaved Willow.

A common willow along streams in the Upper Sonoran zone on both sides of the mountains. Observed at Boulder; Livermore; on Green River near Ladore; and in the lower valleys of Snake and White Rivers.

Salix perrostrata.

Taken in June, 1905, in the foothills near Golden, where small clumps were growing in bogs on the higher slopes between 6,500 and 7,500 feet in the upper Transition zone.

Salix nuttalli. Nuttall Willow.

Scattered clumps were growing with *S. perrostrata*, between 6,500 and 7,500 feet, around springs and in bogs among the foothills near Golden. Willows noted in September, 1906, at springs on the northern slope of the Book Plateau, between 7,500 and 8,000 feet, were probably *S. nuttalli*.

Salix geyeriana.

Dense thickets of this low willow fringe most of the streams and bogs in Middle and Egeria Parks and near Hahns Peak. It was the prevailing species near Coulter in Middle Park and at the eastern end of the Elk Head Mountains near Columbine. It was not observed in the mountains of southern Colorado.

Salix glaucops.

This is perhaps the most abundant alpine willow in the mountains. (See fig. 35.) In June, 1905, I found dense copses on the higher slopes of Mount Kelso between 11,000 and 12,500 feet, and in 1906 it was common on the streams of Egeria Park and the Gore Range. The usual growth of this willow varies from about 4 feet in the lower part of its range in the Canadian zone to 2 feet or even less above timberline. The glabrous-leaved form (*S. g. glabrata*) is common in bogs on the alpine slopes of Mount Kelso.

Salix chlorophylla.

I have found this alpine willow only on Mount Kelso, where it grows on the boggy slopes between 11,000 and 12,500 feet in dense copses from 2 to 4 feet high. It was more abundant above than below timberline.

Betula fontinalis. Rocky Mountain Birch.

This handsome birch forms a conspicuous fringe along foothill streams throughout the State, and often extends out on the plains for some distance. It is usually associated with narrow-leaved cottonwoods and willows, and I have seen it only near stream banks. In July, 1907, I found several large clumps fully 20 feet in height on Dolores River near the mouth of West Creek, at 5,000 feet. The species occurs regularly up to 8,000 and occasionally to 9,000 feet through the entire width of the Transition zone. I did not observe it in the Canadian zone.

I found *B. fontinalis* common at the following localities: Streams of Routt County; North Park; Plateau Creek; Bailey; Lake George; St. Elmo; Frying Pan River, Basalt to Peachblow; head of Smith Fork, West Elk Mountains; Unaweep Canyon; Placerville; Durango; Rico; Mancos; Bayfield; and La Veta.

Betula glandulosa. Dwarf Birch.

The habitat of the dwarf birch is along the borders of cold bogs and streams in the higher mountains, between 9,000 and 11,000 feet, in the upper Canadian and lower Hudsonian zones. It has been found on practically all the higher mountain ranges of the State. The normal growth is from 3 to 5 feet high, but in the Hudsonian zone at about 11,000 feet the species is dwarfed, rarely exceeding 2 feet. It was particularly abundant in 1906 in the mountain meadows on the Park Range and on the mountains east of Laramie River, where a low, dense growth fringed most of the bogs between 9,000 and 10,000 feet. I saw it on Grand River, 5 miles east of Hot Sulphur; on the San Juan Mountains near Ophir, at 10,500 feet; and southeast of Lake City, 9,000 to 11,000 feet. The leaves were falling near Lake City, October 18, 1907.

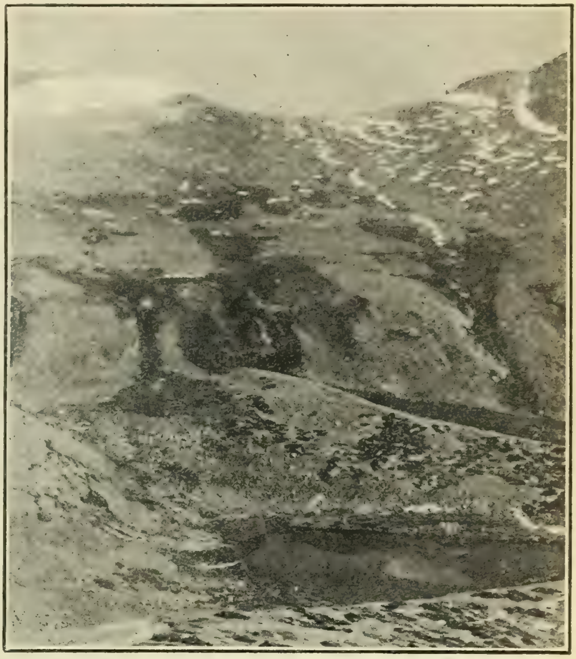

FIG. 35.—Alpine willows in Arctic-Alpine zone, Front Range, near Berthoud Pass.

Alnus tenuifolia. Alder.

Alders form a dense fringe along cold streams throughout the Colorado mountains. They are most abundant in the Canadian zone up to 10,000 feet, but occur regularly as low as 7,000 feet and occasionally to 6,000 feet. The species attains its maximum size along the smaller streams flowing from the Medicine Bow Mountains into North Park, a tributary of Canadian Creek being fringed with alders fully 20 feet in height.

The following localities at which I have noted alders indicate a wide and uniform distribution: Log Cabin, Larimer County; North Park; Hahns Peak; Snake River, Honnold to 10 miles above Slater; Gore Mountains; Fraser River, Middle Park; Smith Fork of Gunnison River, West Elk Mountains; Frying Pan River; Gunnison; Crested Butte; Pitkin; Sapinero, Lake Fork of Gunnison River; Wagon Wheel Gap; Poncha Pass; Creede; Manitou; Bailey, South Platte River; Lake George; Buena Vista; St. Elmo; Lone Cone; Unaweep Canyon; Rico; Silverton; Bayfield; Pagosa Springs; Pagosa Junction; La Veta; and Las Animas River, Segundo to Weston.

Corylus rostrata. Beaked Hazelnut.

Small thickets of hazel are common on Middle Boulder Creek, at Blanchard's ranch, 5 miles west of Boulder, at an elevation of nearly 6,000 feet. I did not observe the beaked hazel elsewhere in Colorado, but Rydberg records it from other points in the eastern foothills from North Cheyenne Canyon north to Larimer County.

Celtis reticulata. Hackberry.

The hackberry has a scattering distribution in the Upper Sonoran zone on both sides of the mountains, being most common on the eastern plains in gulches leading back from stream valleys. Small clumps are found in most of the canyons of the lowest eastern foothills from Boulder north to Fort Collins. I have not found it above 5,500 or 6,000 feet. Its growth in Colorado is uniformly scrubby, and only occasionally does it attain the stature of a tree. Hackberries are common on the bare foothill slopes near Platte Canyon Station, at Golden, Boulder, Arkins, and at a point 8 miles west of Fort Collins. Several large clumps grow in Shell Rock Canyon, northwestern Baca County. At Wray, Yuma County, the species is very common in the gulches leading back from Chief Creek Valley.

Few hackberries were met with in western Colorado. Scattering trees grow on the slopes along Plateau Creek, 5 miles east of Tunnel, Mesa County, and others on West Creek, near its junction with Dolores River, in southwestern Mesa County.

Atriplex canescens. Orache; Gray Saltbush.

This species has a wide range in the Upper Sonoran zone on both sides of the mountains, but is most abundant in western and southern Colorado. I have not observed it much above 7,000 feet. It is a characteristic shrub in the warmer valleys of the eastern foothills south of the Arkansas Valley, where it is locally termed "chico brush."

It often grows to a height of several feet on sandy or alkaline flats in the bottoms of valleys. Pocket gophers appear to feed extensively upon its leaves, which I have often found in their tunnels.

It was noted at the following localities: Lily Park; Midland Basin, Routt County; southwest of Rangely; Escalante Hills; desert north of Mack; Hotchkiss; Montrose; Paradox Valley; Dolores River, near mouth of West Creek; McElmo Valley; Medano Springs ranch, San Luis Valley; Salida; Gardner; La Veta; Limon; and 30 miles northwest of Sterling.

Atriplex confertifolia. Round-leaved Saltbush.

The round-leaved saltbush is a characteristic Upper Sonoran shrub of the desert stretches of western Colorado, growing principally upon dry alkaline flats, but often on sandy areas. Occasionally it forms a dense growth like sagebrush, as on the plains of extreme western Routt County, between the Escalante Hills and Vermilion Bluffs. (See Pl. III, fig. 2.) I observed the species at localities as follows: Lower Snake River Valley east to Baggs Crossing; plains north of Escalante Hills; Browns Park; Lily Park; Midland Basin; Maybell; badlands near Rangely; Evacuation Creek Valley; desert north of Mack; southern slopes of Book Cliffs to Atchee, 7,000 feet; Plateau Creek; Fruita; De Beque; Newcastle; Hotchkiss; Montrose; Paradox Valley; and McElmo Valley east to north base of Mesa Verde at Point Lookout. This species occurs also east of the mountains, as Rydberg records it from Denver and Pueblo.

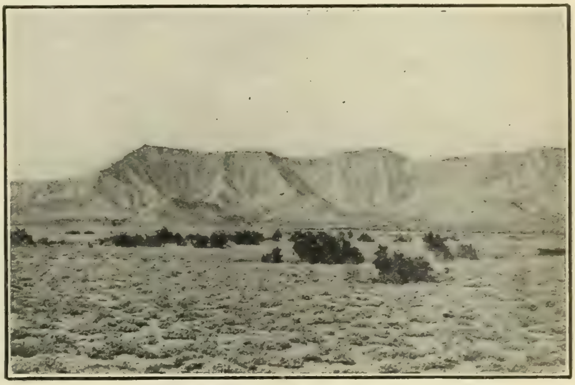

FIG. 36.—Desert vegetation (*Atriplex nuttalli* and *Sarcobatus vermiculatus*) in lower Grand River Valley, north of Mack, at 4,500 feet.

Atriplex nuttalli. Saltbush.

This small shrub, often called salt sage, is a characteristic Upper Sonoran species, found chiefly on alkaline flats in the desert valleys of western Colorado. In some of the dry desert basins it forms the principal shrubby vegetation, although it is of small size and usually more or less prostrate. It is the most conspicuous shrub in Midland Basin, western Routt County; on the desert north of Mack (see fig. 36); and on the alkaline stretch of country between Hotchkiss and the West Elk Mountains. I found it abundant in Browns Park;

along Snake River west of Baggs Crossing; southwest of Rangely; and in McElmo and Uncompahgre Valleys.

Grayia spinosa. Common Grayia.

This low, spiny, mealy shrub is a characteristic plant in the sandy and alkaline Upper Sonoran tracts of northwestern Colorado, where it grows in profusion in river valleys and on the lowest bordering benches up to a little over 6,000 feet. Together with *Atriplex confertifolia*, it forms the principal shrubby growth in some of the river valleys of western Routt and Rio Blanco Counties (see Pl. III, fig. 2). I found it common in the Snake River Valley from 20 miles west of Baggs Crossing to Lily; on the flats between the Escalante Hills and Browns Park; in Midland Basin; in White River Valley from Angora westward to the Utah boundary; on rocky slopes along Bear River at Maybell; on the desert north of Mack, Mesa County; at Rifle, Hotchkiss, and Somerset. In the Browns Park region the leaves had nearly all fallen by the 1st of September.

Grayia brandegei.

The shrubby growth observed on the tops of low mesas along the McElmo Valley near Moqui was probably *G. brandegei*, recorded by Rydberg from the McElmo Valley.

Sarcobatus vermiculatus. Greasewood.

The zonal range of the greasewood is mainly Upper Sonoran. Its wide range over the lower parts of the State is well indicated by the following localities at which it was observed during my explorations: North Park in alkaline situations; Snake River Valley to 5 miles east of Slater at 6,800 feet; Bear River Valley east to Craig and Steamboat Springs; Browns Park (very rank growth, sometimes 12 feet in height); Lily Park; Midland Basin; Rangely; Texas Creek; Evacuation Creek; north of Atchee, southern slope Book Plateau, to 7,500 feet; desert north of Mack (see fig. 36); Plateau Creek; De Beque; Rifle; Dotsero to Eagle; Kremmling and Muddy Creek Valley, Middle Park; Hotchkiss; Montrose region; Dallas Creek near Ridgway; lower valleys of San Miguel and Dolores Rivers; McElmo Valley; Montezuma Valley east to north base of Mesa Verde at Point Lookout; Bayfield; Salida; Gardner; San Luis Valley generally—Alamosa, Saguache, Hooper, Villa Grove, Mosca, and Medano ranch.

Berberis fendleri. Barberry.

In Colorado the barberry appears to be confined to dry rocky slopes and ridges in the region south and west of the San Juan and La Plata Mountains. I found a scattering growth on rocky ridges in the yellow pine forest at Pagosa Springs (7,000 feet), and later met with the species on dry, open slopes at Durango. Rydberg records *B. fendleri* from Durango, Arboles, Mancos, and Mancos Canyon.

Odostemon aquifolium. Oregon Grape.

The Oregon grape has a wide distribution in the Colorado mountains from the foothills to about 10,000 feet. I found it most abundant on cool, shaded slopes in the upper part of the yellow pine belt, where with *Arctostaphylos* it forms the characteristic lower undergrowth. The ripe clusters of bluish berries remain on the shrubs for some time in the autumn. The Oregon grape is abundant at Boulder; Coulter, Middle Park; Floyd Hill; Honnold; northern slopes of Elk Head Mountains; northern slopes and summit of Escalante Hills, 7,000 feet; canyon of the Grand above Glenwood Springs; Unaweep Canyon; Cerro Ridge; Somerset; West Elk Mountains, head of Smith Fork; Sapinero; Dolores; Mesa Verde; Bayfield; Pagosa Springs; Wet Mountains east of Westcliffe; and hills near La Veta.

Odostemon fremonti.

In August, 1907, I found this large prickly-leaved shrub abundant along the Smith Fork of Gunnison River, at the western base of West Elk Mountains, a few miles east of Crawford, Delta County. At this point it was growing among junipers and pinyons on the warm rocky slopes near the stream. Many of the shrubs were 6 or 8 feet in height. Rydberg records *O. fremonti* from Smith Fork Canyon, and it is not known to occur elsewhere in the State.

Edwinia americana.

I have not observed this species west of the Continental Divide, but it is a conspicuous shrub on cliffs and rock ledges on the eastern slope across the State from north to south, chiefly in the Transition zone. It was in full bloom in the foothills west of Boulder June 10, 1905, and the white-flowered cymes were very handsome. It is particularly common in the hills along the South Platte near Bailey, and between Manitou and Woodland Park.

Fendlera rupicola.

In Colorado this low shrub is confined to the southwestern counties, where it is tolerably common on dry slopes and low mesas in the Upper Sonoran and lower Transition zones. It was abundant on the pinyon slopes along the Los Pinos at Bayfield, La Plata County (6,500 feet), and a few of the shrubs were in flower June 5, 1907. It was common in July, 1907, on the low benches along Dolores River between Salt Canyon and the mouth of West Creek, at 5,500 feet, and I noted it for some distance up the valley of West Creek. Rydberg records the species from Durango, Mancos, Cerro Summit, Dolores, Hotchkiss, and Los Pinos.

Ribes cereum. Red Currant.

This is a common currant on dry rocky slopes up to at least 10,000 feet, but is most abundant in the yellow pine belt. Observed at

Boulder; Golden; Pawnee Buttes, northeastern Weld County; Bailey; Manitou; Buena Vista; Como; St. Elmo; Thomasville; Wagon Wheel Gap; Coulter; Escalante Hills; and Pagosa Junction.

Ribes wolfi.

This high-ranging currant is not uncommon in the Canadian and Hudsonian zones, growing even on rocky slopes to a short distance above timberline. It was not observed at any point below 8,000 feet. The black viscid berries were still on the bushes on the summit of the Book Plateau September 22, 1906. It is a common shrub on Lone Cone, San Miguel Mountains; at Thomasville; and on McClellan Mountain between 11,000 and 12,000 feet.

Ribes longiflorum. Golden Currant.

The zonal range of this flowering currant is mainly Upper Sonoran. Its yellow bloom was conspicuous at Boulder June 8, 1905, and along the San Juan River at Pagosa Springs May 27, 1907. This currant was observed also at Golden and at Wray. Vernon Bailey reports it common along streams in the southern end of San Luis Valley.

Opulaster intermedius. Nine bark.

In early June, 1905, I found this handsome flowering shrub in full bloom on Middle Boulder Creek at 5,800 feet, in the Transition zone. Rydberg records it from other points in the eastern foothills of the Front Range.

Opulaster monogynus.

Common in June, 1905, in the foothills near Boulder and Golden between 6,500 and 7,500 feet. This species does not grow along streams like *O. intermedius,* but on dry rocky slopes. Rydberg gives *O. monogynus* a wide distribution in the eastern and central mountain districts.

Rubacer parviflorus. Salmonberry.

The large-leaved salmonberry is conspicuous on cool forested slopes in the Canadian zone throughout the mountains of western and central Colorado, but is uncommon east of the Continental Divide. The large juicy red fruit has a delicious flavor and is usually ripe by the end of August. Salmonberries were found in great abundance on the western slopes of the Park Range east of Steamboat Springs; near Hahns Peak, 8,000 to 8,500 feet; on the Book Plateau; on Lone Cone; and at Thomasville.

Oreobatus deliciosus. False Raspberry.

This is a characteristic shrub in the eastern foothills up to 9,000 or 10,000 feet, but was not observed in the western mountains. In the foothills west of Boulder the large showy white flowers were out June 6, 1905, and the species was flowering at Georgetown June 20. It is particularly abundant in the yellow pine belt at Bailey and on the slopes near Buena Vista. The dark purplish fruit of this shrub is inedible.

Rubus strigosus. Red Raspberry.

Red raspberries were fully ripe on cool north slopes in the yellow pine belt near Arkins July 26, 1906. At this locality they were growing in profusion at 6,000 feet. The species is common at Ophir, St. Elmo, Thomasville, and on the eastern slopes of the Sangre de Cristo Range in western Huerfano County. It is usually found in slide rock or in areas which have been swept by forest fires.

Dasiphora fruticosa. Shrubby Cinquefoil.

The shrubby cinquefoil is one of the most showy flowering shrubs in mountain meadows and on open slopes between 8,000 and 11,000 feet. It occurs in greatest abundance in wet meadows in the high mountain parks at 9,000 or 10,000 feet in the Canadian zone. The large yellow flowers dotted the upper slopes of Mount McClellan between 10,500 and 11,000 feet during the middle of June, 1905, and the species was flowering at 10,000 feet on the South Park plains at Como as late as August 21, 1907. Above 11,000 feet *Dasiphora* occurs in a dwarfed state not over a foot high—about half its normal growth. It is an abundant shrub near Pearl, in northwestern North Park, at 8,700 feet, where it was flowering August 8, 1906. I observed the species on the White River and Uncompahgre Plateaus; at Divide, Teller County; in Slate River Valley between Almont and Crested Butte; and in the meadows along the headwaters of Cebolla Creek, southeast of Lake City, up to 11,000 feet.

Holodiscus dumosus.

This handsome flowering shrub is conspicuous among rocks in the foothill districts up to 9,000 feet on both slopes of the mountains. The species occurs mainly in the Transition zone. It was in flower July 12, 1905, in the canyon along Grand River just west of Hot Sulphur. I have found it common in the canyon of the Grand above Glenwood Springs; in Unaweep Canyon; on the Uncompahgre Plateau, head of Dominguez Creek; at Ouray; Buena Vista; and in the Wet Mountains east of Westcliffe, 9,500 feet.

Kunzia tridentata.

This species is generally distributed over the mountainous sections of the State from 6,000 to 9,500 feet. It is usually present on dry open hills and was not observed in heavy forests. It forms dense thickets in the sand dunes along the western base of the Medicine Bow Range in North Park, and in the sandy yellow pine country on the head of Dominguez Creek, at the northern end of Uncompahgre Plateau. At a little distance this species bears a close resemblance to sagebrush (*Artemisia tridentata*), but is darker green and seldom grows to a height of more than 2 feet. It is usually in full bloom by the 1st of July.

K. tridentata was observed at the following localities: Nederland; Elkhorn, Larimer County; bare hillsides along Snake River at Slater; Canadian Creek, North Park; Coulter, Middle Park; river bluffs near Baggs Crossing; watershed between Snake and Bear Rivers; O-wi-yu-kuts Plateau; Escalante Hills; Book Plateau (a little on 8,500 foot summit at Columbine); canyon of the Grand above Glenwood Springs; Somerset; Dillon; Sapinero; Arboles; East Paradox Valley (rare); and Uncompahgre Plateau.

Cowania mexicana. Cliff Rose.

The handsome cliff rose is restricted in Colorado to the warm valleys and lower mesas of the southwestern counties, where it has an irregular distribution from the Mesa Verde north to Unaweep Canyon. The growth is usually from 4 to 6 feet. The species forms the most conspicuous shrubbery on the warm open rocky slopes along the north side of Unaweep Canyon, at the northern end of the Uncompahgre Plateau, where it occurs up to 7,000 feet. By the end of July, 1907, it had ceased blooming in Unaweep Canyon and also on the lower slopes of Salt Canyon, between Sinbad Valley and Dolores River, at 5,500 feet. Cliff roses were a mass of yellow bloom June 13, 1907, along the rocky rims of Navajo Canyon, Mesa Verde, at 7,000 feet. Here they were growing commonly among junipers and pinyons, often on rocks where there was scarcely any soil.

Cercocarpus parvifolius. Mountain Holly.

The mountain holly is almost omnipresent on the warmer foothill slopes from the lowest edge of the pinyon belt to the upper edge of the yellow pine belt, on both slopes of the mountains. It forms a dense growth, covering many of the open slopes along the lowest edge of the foothills, and it is common on the higher rocky ridges on the plains of northeastern Colorado at a little over 5,000 feet.

The following localities show the wide range of *C. parvifolius:* Livermore; Pawnee Buttes, Weld County; Platte Canyon Station; Bailey; Salida; Golden; Boulder; Manitou; Eastonville; Walsenburg; Gardner; Trinidad; Slater; Godiva Ridge; Escalante Hills; O-wi-yu-kuts Plateau; south of Lily; southwest of Rangely; Plateau Creek; De Beque; Meeker; West Elk Mountains east of Crawford; Somerset; Cerro Summit; Ouray; Placerville; Naturita; Sinbad Valley, above 6,000 feet; Dolores; Ute Peak, lower slopes; Mancos; Mesa Verde; Arboles; Bayfield; and Wagon Wheel Gap.

Cercocarpus ledifolius. Mountain Mahogany.

The mountain mahogany was noted on the 7,000-foot crest of the Escalante Hills near Douglas Spring, in western Routt County, where

I found it growing commonly on rocky ridges among the yellow pines in September, 1906. Apparently it does not occur elsewhere in Colorado.

Rosa manca. Rose.

This handsome rose grows in profusion in openings along the crest of the Uncompahgre Plateau at about 9,000 feet. The bushes were a mass of pink bloom near Uncompahgre Butte July 16, 1907.

A great variety of wild roses grow in the Colorado mountains up to 10,000 feet, and are in flower nearly all summer. Since few specimens were collected, I am unable to correlate my notes with the various species and can give no data of consequence on their distribution.

Amelanchier bakeri. June Berry.

This June berry was collected on West Creek, near its junction with Dolores River, in western Mesa County. It is a common shrub in the Unaweep Canyon and also on the summit and upper slopes of Mesa Verde, where it forms a dense chaparral. This is probably the species so abundant over most of the mesas from western Montezuma County north to Mesa County, in the Transition zone.

Amelanchier oreophila.

An *Amelanchier* which I collected on Lone Mesa, Dolores County, in June, 1907, proves to belong to this species. Scattering shrubs of small size were growing among the oak chaparral on the dry upper slopes at 9,400 feet, in the lower Canadian zone. I did not collect it elsewhere, but Rydberg gives it a wide range on the western slope.

Amelanchier alnifolia. Common June Berry.

As few specimens of June berries were preserved, the distribution data given below doubtless refers to several species. *A. alnifolia* is, however, the widest ranging species in the State. June berries are abundant on the dry, partially open Transition slopes throughout the mountains, and on many of the western mesas they often form a dense chaparral. Some years they bear an abundance of fruit, but usually it is rather scanty and of poor quality. The berries are eagerly eaten by birds and chipmunks. I observed the shrubs in abundance at the following localities: Hahns Peak, below 8,500 feet; slopes along Snake River between Honnold and Baggs Crossing; Godiva Ridge; O-wi-yu-kuts Plateau; Escalante Hills, above 6,400 feet; south of Lily; southwest of Rangely; Book Plateau, everywhere above 6,500 feet; Plateau Creek; south of De Beque; canyon of the Grand above Glenwood Springs; bluffs between Dotsero and Wolcott; summit of Piney Divide, 8,500 feet; Transition slopes bordering Sinbad Valley; Lone Cone; Dolores; Mancos; Durango; Bayfield; Pagosa Springs; Pagosa Junction; and La Veta.

Peraphyllum ramosissimum. Dwarf Apple.

I found this shrub in great abundance on dry open hillsides south and west of the San Juan and La Plata Mountains, chiefly between 6,500 and 7,500 feet. The dry slopes along the Los Pinos at Bayfield were covered with a mass of its pale roseate blossoms the first week in June, 1907, and it was in flower up to the middle of the month on the Mesa Verde. It was noted as follows: South slope of Book Plateau above Atchee, 8,000 feet; Newcastle; East Fork of Rifle Creek; canyon of the Grand above Glenwood Springs; Basalt; Somerset; rocky slopes near Hotchkiss; Montrose region above 7,000 feet; north base of Lone Cone at 7,000 feet; Sinbad Valley rim above 6,000 feet; Dolores; McElmo Valley; Arboles; and Bayfield.

Prunus americana. Wild Plum.

This species occurs sparingly in gulches on the eastern plains and at the eastern base of the foothills in the Upper Sonoran zone. Thickets of wild plum were observed at Wray; Gaume's ranch, northwestern Baca County; Arkins; and Boulder. Rydberg records the species from a number of localities extending across the State from north to south at the base of the foothills.

Prunus pennsylvanica. Red Cherry.

Rydberg gives the red cherry a wide range in the eastern foothills of the Front Range up to 9,500 feet. I found it common in the foothills at Boulder and Manitou.

Prunus melanocarpa. Chokecherry.

This species appears from my observations to be the common wild cherry of the mountains, particularly in western Colorado. The growth is uniformly scrubby, often forming a dense chaparral on the Transition zone summits and upper slopes of plateaus and mesas in the western counties. It is sparingly present in gulches on the eastern plains. The following are localities at which *P. melanocarpa* was observed: Northern slopes Elk Head Mountains, 7,800 feet; Slater to Baggs Crossing; White River below Angora; Book Plateau, dense chaparral 7,000 feet to summit; Glenwood Springs; summit of Piney Divide, 8,000 feet; Pitkin; Somerset; lower slopes of Lone Cone; Uncompahgre Plateau; Placerville; Ouray; Vernal Mesa; West Elk Mountains east of Crawford; Frying Pan River, Basalt to Thomasville; Dolores; Mancos; Hermosa; Arboles; Pagosa Springs; Sterling; Wray; and Tuttle.

Robinia neomexicana. Locust.

A very few of these locusts were observed on the rocky banks of Grand River near Tunnel, Mesa County, at about 5,000 feet. Recorded by Rydberg from Denver, Walsenburg, La Veta, and Trinidad.

Rhus rydbergi. Poison Ivy.

The poison ivy is common in canyons on the eastern plains and also in the lower eastern foothills of the Front Range. It was observed at Tuttle; Wray; Pawnee Buttes; in gulches along the southern escarpment of the Chimney Cliffs, 30 miles northwest of Sterling; in the foothills at Boulder and Golden; and it was collected in Navajo Canyon, Mesa Verde, southwest Colorado.

Schmaltzia glabra. Sumac.

This sumac I have found sparingly up to 6,000 feet in the foothills west of Boulder and Golden, and also near Livermore and Platte Canyon Station. Its brilliant reddish autumnal foliage was very conspicuous on the slopes along Middle Boulder Creek October 20, 1906, when the leaves had just commenced to fall.

Schmaltzia trilobata. Skunk Bush.

The zonal range of this sumac is mainly Upper Sonoran, and it is equally abundant on both sides of the mountains. In the foothills it usually grows on the warm sides of canyons and along streams. In the warm desert valleys of western Colorado it is often found with sagebrush in the open, but also forms a good growth along watercourses, where it sometimes attains a height of 8 or 10 feet. East of the mountains this sumac occurs chiefly in gulches in the rougher parts of the plains.

S. trilobata was observed as follows: Tuttle; Wray; bluffs east of Sterling; Chimney Cliffs; Pawnee Buttes; Gaume's ranch, northwestern Baca County; Livermore, dry slopes up to 6,500 feet; Boulder; Golden; Platte Canyon Station; Segundo; Buena Vista, up to 8,500 feet; bluffs along Snake River below Baggs Crossing; Plateau Creek; Basalt; Hotchkiss; Naturita; Sinbad Valley; West Creek; McElmo; and Pagosa Springs.

Pachystima myrsinites.

This little evergreen shrub is abundant throughout the mountains, growing in dense clumps in wooded gulches and on shaded north slopes between 6,000 and 9,000 feet. It was found in abundance at the following localities: Northern slopes of Elk Head Mountains at 7,800 feet; Park Range up to 9,000 feet; canyon of the Grand above Glenwood Springs; summit of Escalante Hills; Book Plateau, 8,000 feet; Navajo Canyon, 7,000 feet; and northern escarpment of Mesa Verde.

Acer glabrum. Mountain Maple.

The mountain maple is common and widely distributed in the mountains of Colorado, growing in greatest profusion on damp shaded slopes between 5,500 and 9,000 feet and forming dense clumps on the borders of streams and bogs. The bright yellow autumnal foliage gives a brilliant coloring to the mountain slopes in late September. The average height is not over 8 feet, although 12 feet is sometimes attained. I have found this species especially common among the eastern gulches of the Front Range and on both slopes of the Saguache Range. It occurs on the northern slope of the Book Cliffs and is abundant at Aspen and in most of the mountains of southern Colorado.

Acer negundo. Box Elder.

Box elders are common trees on most of the streams of the eastern plains and scattered clumps are often met with on foothill streams to elevations of 7,000 or 8,000 feet on both sides of the mountains. The zonal distribution is mainly Upper Sonoran. In my trips over the State I have found box elders at the following localities: Snake River, from 5 miles east of Slater to Baggs Crossing; southern slopes of Book Cliffs near Atchee at 7,500 feet; Rifle Creek; canyon of Plateau Creek; canyon of the Grand above Glenwood Springs; Frying Pan River, Basalt to Peachblow; Ouray; Unaweep Canyon; Wray; Platte Canyon Station; Las Animas River, Segundo to Weston; and Shell Rock Canyon, northwestern Baca County.

Rhamnus smithi. Buckthorn.

This species is known apparently from only two localities in the State. It was abundant and in flower May 27 on the banks of San Juan River at Pagosa Springs (7,000 feet), and was again encountered in the hot canyon of Dolores River between Salt Canyon and the mouth of West Creek at about 5,000 feet. Dense spreading thickets of buckthorn, often 10 or 12 feet high, fringed Dolores River for most of this distance and extended eastward in the West Creek Valley to an elevation of 5,500 feet. The black-green foliage of *R. smithi* was in marked contrast to the predominant gray-green desert vegetation along the Dolores and on the bordering canyon sides. The fruit of this shrub had nearly all turned to a rich purplish black, July 13, 1907, but some was still green or only partially colored. This species has been recorded from Pagosa Springs by Rydberg.

Ceanothus velutinus. Mountain Balm.

This shrub forms a dense chaparral about 2 feet in height on the central slopes of most of the mountain ranges of northern Colorado, extending south to Thomasville on the western slope of the Saguache Range. I did not see it on any of the mountains of southern Colorado. The rankest growth was observed in the Middle Park region, on the Park Range, and on the hills around Steamboat Springs, where in places the dense thickets were well-nigh impassable. The species is occasionally found as low as 6,500 feet, but usually grows between

7,500 and 9,500 feet. It is most abundant on dry, partially open slopes which have been burned over by forest fires. The oval bright green leaves are remarkably shiny and glabrous, giving a peculiar brilliance to this chaparral on a bright day.

Other points where I observed *C. velutinus* are: Northern slopes of Elk Head Mountains; bluffs along Snake River, 10 miles east of Slater; Escalante Hills, 7,000 feet; watershed between Bear and White Rivers, north of Midland Basin, 6,500 feet; juniper slopes at McCoy, 7,000 feet; northern slopes of Piney Divide, 8,000 feet; Coulter, Middle Park; northern slopes of Book Plateau; and Dillon.

Ceanothus pubescens.

This is a common shrub on dry rocky slopes in the eastern foothills of the front ranges, chiefly in the Transition zone. I found it abundant also in sandy yellow pine forest near the head of Dominguez Creek on the Uncompahgre Plateau, at 8,000 feet. It is common in the foothills near Boulder and La Veta.

Ceanothus fendleri.

This species is common in the Transition zone over most of the State, according to the range given by Rydberg. I have met with it only in the southwest on the summit of Lone Mesa, 9,400 feet, and on the open gravelly benches along McElmo Creek in western Montezuma County, 5,500 feet.

Cactus missouriensis. Ball Cactus.

The common ball cactus is abundant on the high plains from the Arkansas Divide near Cheyenne Wells northwest to Weld and Logan Counties. I have found it common on the South Park plains near Como up to 10,000 feet, in the yellow pine belt at Bailey, and on the sage plains of western Routt County.

Cactus radiosus.

This ball cactus is tolerably common among rocks in the pinyon belt at Coventry, in western Montrose County, where I collected specimens in July, 1907, at an elevation of 6,500 feet.

Echinocactus simpsoni. Snake Cactus.

This peculiar cactus is found chiefly at the higher elevations. In November, 1907, I found it common in Wet Mountain Valley; in the Wet Mountains east of Westcliffe between 9,000 and 9,500 feet; and on the eastern slopes of the Sangre de Cristo Range near Mosca Pass—both in yellow pine forest and in the open.

Echinocereus viridiflorus. Cereus.

This greenish flowered cereus is abundant in the eastern foothills of the front ranges across the State from north to south. It ascends to at least 9,000 feet in the Wet Mountains east of Westcliffe, where in November, 1907, I found it in rocky soil among the yellow pines. It was common at Walsenburg, 7,000 feet; and at Gaume's ranch, in Shell Rock Canyon, northwestern Baca County, it was abundant among rocks at 4,600 feet. The species was not observed in western Colorado.

Echinocereus paucispinus.

This cereus is not uncommon in the rocky pinyon and juniper country of southwestern Colorado, chiefly below 7,500 feet. It was taken north of Dolores at 7,500 feet, and was very common at Coventry. It is recorded from Durango by Rydberg.

Opuntia polyacantha. Prickly Pear.

This is an Upper Sonoran species, occasionally growing to 7,000 feet on warm slopes in the foothill valleys. It is of general occurrence on the plains east of the mountains, where it is the common prickly pear, and it is present on the sage plains of Routt County. The yellow flowers usually dot the plains during the first two weeks in June. It is common at Slater; Snake River Valley; Maybell; Boulder; Fort Collins; Sterling; Pawnee Buttes; Platte Canyon Station; Limon; Wray; Cheyenne Wells; Pueblo; Walsenburg; Salida; and Gaume's ranch, northwestern Baca County.

Opuntia rhodantha.

This handsome red-flowered prickly pear is abundant in the warm valleys of extreme southwestern Colorado. At McElmo it was in bloom during the middle of June, 1907. Rydberg records it from Grand Junction and Boulder.

Opuntia camanchica.

A large-jointed species, chiefly of southwestern Colorado—McElmo, Cortez, Dolores, Coventry, and Paradox Valley. It was in flower in McElmo Valley June 15 to 22, 1907. Rydberg records it from Colorado Springs.

Opuntia fragilis.

This small-jointed species is not uncommon in the foothill districts between 6,000 and 8,500 feet, in the Transition zone. It was growing in rocky situations in the yellow pine forest near Pagosa Springs, and also on the northern end of the Uncompahgre Plateau, and was occasionally noted on the high plains near Pawnee Buttes, in northeastern Weld County. It was observed on rocky juniper slopes along the head of Smith Fork, West Elk Mountains; at Somerset; Buena Vista; Plateau Creek, Mesa County; and Unaweep Canyon. Rydberg records it from Denver and Boulder.

Opuntia arborescens. Tree Cactus.

The tree cactus is a characteristic Upper Sonoran species from the Arkansas Valley southward (see fig. 37), and over much of southeastern Colorado is the most prominent shrub on the level plains. It extends some distance into the foothills along the warmest slopes of the valleys, reaching its western limit in the Arkansas Valley at a point 5 miles east of Salida, and in the Huerfano Valley a short distance above Gardner. It reaches at Fountain its northern limit along Fountain Creek, and it occurs near Trinidad in the Las Animas Valley, and at Walsenburg in the Cucharas Valley. It is particularly abundant in the canyons of Las Animas and western Baca Counties.

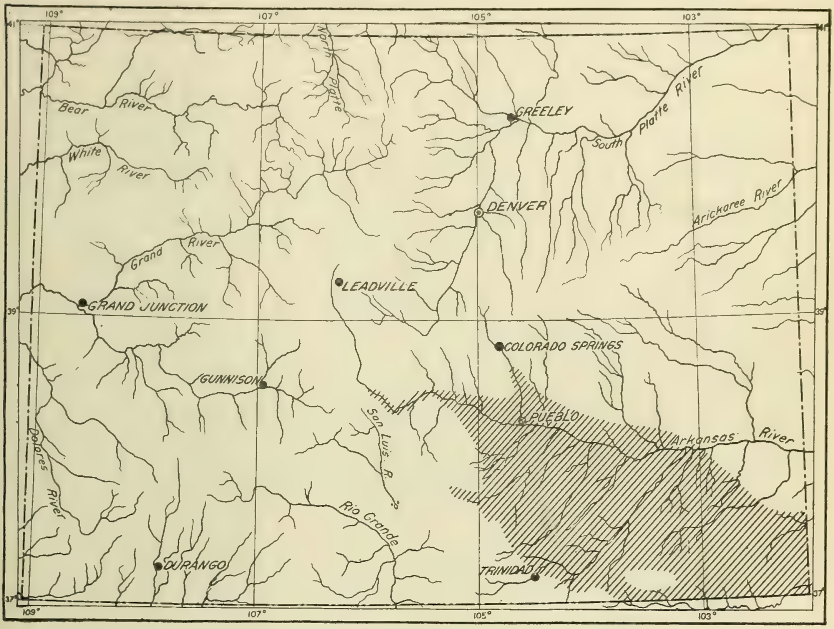
109°
107°
105°
103°
41
39
37
North Platte
Bear River
White River
Grand River
GREELEY
South Platte River
DENVER
Arickaree River
LEADVILLE
GRAND JUNCTION
COLORADO SPRINGS
GUNNISON
PUEBLO
Arkansas River
San Luis R.
Rio Grande
Dolores River
DURANGO
TRINIDAD

FIG. 37.—Distribution in Colorado of tree cactus (*Opuntia arborescens*).

Lepargyrea argentea. Buffalo Berry.

Dense thickets of buffalo berry are present along many of the streams of the plains on both sides of the Continental Divide, and the species extends into the foothills along some of the watercourses to an elevation of from 6,000 to 7,000 feet. The zonal distribution is mainly Upper Sonoran. Sandy river banks are especially suited to the growth of the buffalo berry. The brilliant scarlet clusters of berries are usually ripe by the middle or end of August, and are eagerly eaten by sage thrashers and many other birds. In late August, 1907, chipmunks (*Eutamias minimus*) were feeding extensively upon the ripe buffalo berries in the Snake River Valley. We found the berries when cooked and used as sauce a welcome addition to our camp fare, but uncooked they are extremely acid. Observed at La Porte; Snake River Valley, Slater to Lily; Browns Park; White River Valley, Angora to Rangely; Dotsero to Eagle; Newcastle; Dallas Creek, near Ridgway; Basalt; Hotchkiss; near Montrose; Naturita; Pagosa Junction; Arboles; and along most of the streams on the eastern plains.

Lepargyrea canadensis. Canadian Buffalo Berry.

This is a characteristic Canadian zone shrub in the mountains of northern and central Colorado, becoming less common toward the south. It is conspicuous in the undergrowth of the dry lodgepole pine forests of the central mountain slopes between 8,000 and 10,000 feet, but I have not observed it much lower. Above 10,000 feet it becomes decumbent, often not more than a foot high, and is of rare occurrence above 11,000 feet. The bright red berries of this buffalo berry have an attractive appearance, but are unpalatable and very bitter. They are ripe by the 1st of August, and usually remain on the bushes during most of that month. The leathery leaves had nearly all fallen at St. Elmo, in the Saguache Range, at 10,000 feet, October 9, 1907.

I found *L. canadensis* at the following localities: Eight thousand five hundred to ten thousand feet on the Medicine Bow and Laramie Mountains; Park Range, west of Pearl, 9,000 to 10,000 feet; Ophir, to 10,500 feet; Culebra Range, near La Veta; Thomasville; Floyd Hill; Como; Dillon; and St. Elmo. Rydberg mentions its occurrence in the southwestern mountains—near Ouray and on Bear Creek Divide in the West La Plata Mountains.

Svida stolonifera riparia. Red-osier Dogwood.

The dogwood or cornel is a prominent shrub along streams in the Transition zone nearly throughout the mountains, and its clusters of white berries are very conspicuous in autumn. Rydberg records another species (*S. interior*) from several points in the foothills, but in my trips through the mountains I have met with only the present species. I observed the cornel on Plateau Creek, east of Tunnel; along White River at Meeker; on the upper reaches of Smith Fork, in the West Elk Mountains; along streams heading in Book Cliffs, above 7,500 feet; and on most of the streams on the eastern slopes of the Front Range.

Arctostaphylos uvaursi. Red Bearberry.

This handsome bearberry is one of the most widely distributed mountain shrubs in Colorado, growing on practically all the ranges from 6,000 to 10,000 feet. It grows luxuriantly on dry shaded slopes beneath lodgepole and yellow pine forest, and the trailing mats of rich dark green are usually very dense and of considerable extent.

I found the red bearberry abundant at Thomasville; Dillon; Como; St. Elmo; Escalante Hills, summit at 7,000 feet; Wet Mountains, east of Westcliffe; Bradford, Huerfano County; foothills west of Boulder; Coulter, Middle Park; Divide; and in the yellow pine forest on the Arkansas Divide at Eastonville.

Arctostaphylos pungens platyphylla. Manzanita.

The manzanita is found on the dry slopes of the Uncompahgre Plateau and on the eastern slopes of the La Sal Mountains in western Montrose County. It appears not to have been recorded previously from the State.

In July, 1907, I noted a scattering growth on the head of Dominguez Creek, at the northern end of the Uncompahgre Plateau, and in descending the steep southwestern escarpment north of Tabeguache Creek a dense chaparral of this manzanita was traversed on the rocky slopes immediately below the aspen belt, at about 8,000 feet. I found it a common undershrub in the yellow pine forest just above the western rim of West Paradox Valley, between 7,000 and 8,000 feet. The species came under my observation only in the Transition zone and appears to grow principally on dry, partially open slopes.

Vaccinium cæspitosum. Huckleberry; Blueberry.

This blueberry is common from Yankee Doodle Lake (10,500 feet) to timberline on Rollins Pass; at Ophir (10,500 feet) to timberline; and on the upper slopes of Lone Cone. It is most abundant on the mossy floor of the Canadian zone forests.

Vaccinium oreophilum. Bilberry.

The bilberry forms low, dense carpets 8 or 10 inches high in the lodgepole pine and Engelmann spruce forests between 8,000 and 11,000 feet, and is particularly abundant on the Front, Park, and Gore Ranges. (See fig. 38.) I found it on Mount McClellan and near Berthoud Pass at 11,000 feet altitude.

Vaccinium erythrococcum. Small-leaved Bilberry.

This diminutive small-leaved bilberry occurs on Mount McClellan between 11,000 feet and timberline, and was observed on Berthoud Pass, Buffalo Pass, and on the Park Range along the headwaters of Grand Encampment River. Rydberg records it from a number of localities on the Front, Saguache, Park, and Sangre de Cristo Ranges.

Fraxinus anomala. Ash.

This small Sonoran species I saw only in the warmer parts of southwestern Colorado, where it was observed at several localities from Mesa County south to Montezuma County at elevations varying from 5,000 to 5,500 feet. It usually grows to a height of from 6 to 10 feet, and single trees or small clumps are scattered here and there in gulches and on the warm rocky slopes in canyons. It was observed in the following places: Slopes bordering McElmo Valley, between Moqui and McElmo; Salt Canyon, the outlet of Sinbad Valley; canyon of Dolores River down to the mouth of West Creek; western (lower) part of Unaweep Canyon; and lower slopes bordering West Paradox Valley. Rydberg records this species from Grand Junction, Deer River, and between Hotchkiss and Smith Fork.

Lycium pallidum. Matrimony Vine.

This species is restricted in Colorado, so far as known, to the low arid Upper Sonoran stretches of the extreme southwest. I found a scattering growth in the partially open sage and pinyon country between Bayfield and Ignacio, La Plata County. It is recorded by Rydberg from McElmo Creek and San Juan Valley.

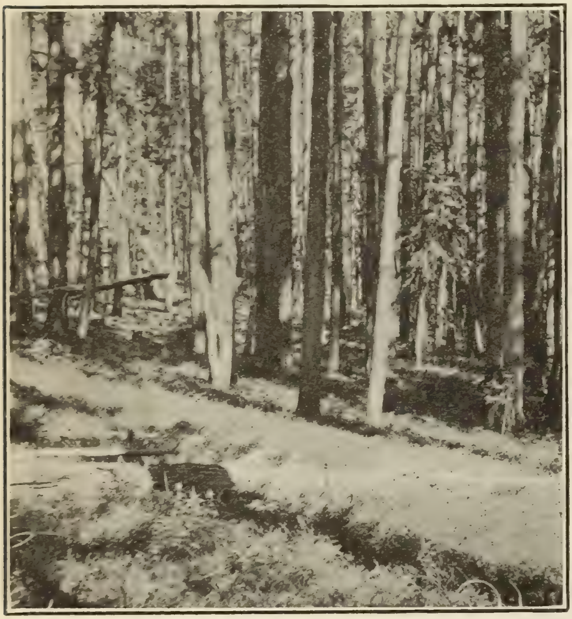

FIG. 38.—*Vaccinium oreophilum* on the floor of lodgepole pine forest, Park Range, west of North Park, 10,000 feet.

Sambucus microbotrys. Elder.

This elderberry is abundant in the Canadian zone forest throughout the mountains between 8,000 and 10,500 feet. I have seldom observed it in the Transition zone, but occasionally it occurs nearly to timberline. The red berries are usually ripe by the middle of August or the first of September. *S. microbotrys* is abundant on both slopes of the Front Range; at Pearl, North Park; Buffalo Pass, Park Range; summit of Continental Divide; north of Hahns Peak; Arapahoe Pass, Rabbit Ear Mountains; Thomasville; Dillon; St. Elmo; headwaters of Cebolla Creek southeast of Lake City; and Lone Cone.

Sambucus melanocarpa.

This is a lower ranging species than *S. microbotrys*, and grows more in the open and chiefly in the Transition zone. I met with it only in western Colorado, but Rydberg records it from several points in the eastern foothills of the Front Range. It was noted as follows: Western slope of Continental Divide north of Hahns Peak, 9,000 feet; Hahns Peak; Escalante Hills, 6,400 to 7,000 feet; and Uncompahgre Plateau, 8,000 feet. It was growing in profusion on the rocky northern slopes and along the crest of the Escalante Hills, where the black berries were fully ripe September 3, 1906.

Viburnum pauciflorum. Few-flowered Viburnum.

This small viburnum was observed only at Arapahoe Pass, Rabbit Ear Mountains, at an elevation of 9,000 feet. Rydberg records it from Grand Lake, Minnehaha, and Clear Creek.

Linnæa americana. Twinflower.

The twinflower occurs on the higher slopes of the front ranges nearly across the State, according to Rydberg. I collected it at 10,000 feet near Idlewild on the Middle Park slope of the Front Range, and observed it near Mount Whiteley in northwestern Middle Park, at about 8,500 feet—both localities being in the Canadian zone. Near Idlewild this small trailing vine was abundant on mossy slopes in the damp Engelmann spruce forest.

Symphoricarpos occidentalis. Wolfberry.

The wolfberry is a very abundant shrub on the banks of the South Platte River near Sterling, where it forms dense thickets about 2 feet high. I found it also at Golden. Rydberg records it from a number of localities along the eastern base of the foothills.

Symphoricarpos oreophilus. Snowberry.

A dense scrubby growth of this small-leaved snowberry covers many open mountain slopes in the Transition zone, particularly in western Colorado. It is rarely found in forests or damp situations, but grows rampant on dry, rocky hillsides and mesas. It occurs in abundance in the following localities: Hahns Peak region below 8,500 feet; Escalante Hills; divide between Bear and White Rivers; southwest of Rangely; Book Plateau above 6,500 feet; canyon of the Grand above Glenwood Springs; Mount Whiteley; West Elk Mountains east of Crawford; Vernal Mesa; Somerset; Uncompahgre Plateau; Lone Cone; and Ute Peak.

Distegia involucrata. Involucred Fly Honeysuckle.

Throughout the mountains this honeysuckle is a common and conspicuous undershrub in the forests of the middle slopes. It usually grows in damp situations and is particularly common along streams, where it reaches its rankest growth. I have found it as low as 7,000 feet along cold streams in various parts of the mountains, and it was common at 10,500 feet on the upper reaches of Cebolla Creek in the San Juan Mountains southeast of Lake City. The dark purplish or blackish berries usually fall in late August.

Artemisia tridentata. Sagebrush.

The common sagebrush is almost omnipresent on the higher plains of western Colorado and also in most of the higher mountain parks up to 10,000 feet, but was not noted on the plains east of the mountains. It grows on an average about 2 feet high, but under favorable conditions attains a height of 6 feet or more. The rankest growth I have observed was on the banks of sandy arroyos near Lay, Routt County, where many of the shrubs were 8 or 10 feet in height. *A. tridentata* is abundant at the following localities: Glendevey, Laramie Valley; Livermore; North Park plains (see fig. 39); Hahns Peak to Slater; Snake River Valley; Iron Springs Divide; Lily Park; southwest of Rangely; Plateau Creek; De Beque to Glenwood and Dotsero, Grand River Valley; Wolcott; Piney Divide; McCoy; Egeria Park; parks in Gore Mountains; Middle Park; Roaring Fork Valley to Aspen; Uncompahgre Plateau; Lone Cone; Lone Mesa; Naturita; Coventry; Cerro Ridge; Somerset; Sapinero; Gunnison; Creede; Poncha Pass; Buena Vista; Leadville; Hotchkiss; Saguache; Bayfield; Arboles; and McElmo.

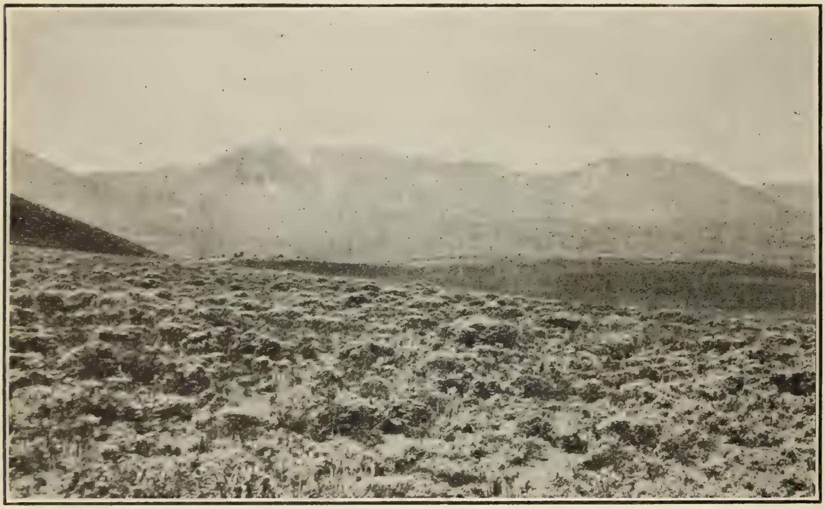

FIG. 39.—Desert sagebrush (*Artemisia tridentata*) on plains near Higho, North Park. (Park Range in the distance.)

Artemisia cana.

This sage occurs in Colorado at a somewhat higher average elevation than *A. tridentata*, although at many points the two species grow together. It was found in abundance at Coulter, Middle Park; near Toponas, Egeria Park; on the Uncompahgre Plateau; and on the lower slopes of Lone Cone, in the San Miguel Mountains. Rydberg records it from Breckenridge; Marshall Pass; Hayden Flats, Routt County; Hebron, North Park; and Timnath.

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